LIBRARY OF CONG...
AUG 1 1892

THE AMERICAN GAS LIGHT JOURNAL

REDMAN & KENNY, N.Y.

PUBLISHING OFFICE No. 32 PINE STREET

DEVOTED TO THE INTERESTS OF ILLUMINATION, VENTILATION, WATER SUPPLY AND DISTRIBUTION, & GENERAL SCIENCE.

VOLUME LVII.—No. 5. Whole No. 895. | NEW YORK, MONDAY, AUGUST 1, 1892. | $3 PER ANNUM, IN ADVANCE.

A. M. CALLENDER & CO., Proprietors. C. E. SANDERSON, Manager.
JOS. R. THOMAS, C.E., Editor. T. J. CUNNINGHAM, Asst. Editor.

ENTERED AT THE POST OFFICE AT NEW YORK, N. Y., AS SECOND CLASS MATTER.

Published on each Monday of the year, at No. 32 Pine Street, N. Y.

Terms of Subscription, Including Postage.—For the United States and Canada, $3 per annum. European countries, $4.50 (19 shillings—22½ francs). All payments to be made in advance. Single copies, 10 cents.

Remittances should be made either by post-office order, express money order-registered letter, or bank draft on New York, payable to the order of A. M. Callender & Co.

Collections are invariably made directly from this office, for subscriptions, advertisements, etc. We have agents to solicit the same, but they are not authorized to receipt for money.

The American News Company, Nos. 39 and 41 Chambers street, New York, are agents for this JOURNAL. Newsdealers will send orders to them.

Correspondence.—Wishing to make this JOURNAL a gazette of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, correspondence is solicited for publication from all who make the study of those subjects a pleasure or a profession.

Books.—We will forward by express, at publisher's lowest rates, any book—scientific or otherwise—to any address in the United States or Canada. We would suggest to our patrons that to avoid the risk and expense consequent on sending us the money (we do not send books C.O.D.), that orders for books be sent us through the Purchasing Department of the American Express Company.

CONTENTS.

An Asterisk (*) denotes an illustrated article.

EDITORIALS—
The Fair Fund 145
Briefly Told 146
The July Outing of the Gas Club, of Chicago—Annual Meeting of the Nashua (N. H.) Light, Heat and Power Company—Consolidation at Huntington, West Va.
A Century of Work on the Development of Light from Coal Gas, by Prof. Vivian B. Lewes, F.I.C. 146
Inconsistencies of Organized Labor 150
*A Convenient Tool for Pipe Fitters 151
The Estimating of Nitrogen in Coal Gas 151
Ventilation and Measurement of Cubic Space 153
Gas Furnace Valves, by Mr. J. W. Wailes 154
Field Riveting, by Z. Foster, C.E. 155
ITEMS OF INTEREST FROM VARIOUS LOCALITIES 156
Changes at Fishkill, N. Y.—A Contract for the Lion Gas Stove Company—Annual Meeting, Bridgeton, N. J.—Mr. W. W. Prichard Takes Charge at Portsmouth, Ohio.—Cheaper Gas for Englewood, N. J.—Pintsch System for Toledo, Ohio.—And Possibly at Ashtabula—Capt. Ross to Go to Mexico—Gas Stoves Becoming Popular at Dallas, Texas—Gas Company for Crookston, Minn.—Capital Stock Increased at Albany, N. Y.—Gas Developments at Boston, Mass.—Mr. Barker Goes to Europe.—Something About the Metropolitan Company, of Elizabeth, N. J.—Annual Meeting, St. Paul, Minn.—Gas Company for Manchester, Va.—Cheaper Gas for Gloucester, Mass.—Annual Meeting, Nantucket, Mass.—At Baltimore, Md.—At Duluth, Minn.—And Other Items.
The Market for Gas Securities 158

THE FAIR FUND.

The hot weather of the past week seems to have wilted the subscription to the Fair Fund; nor can we say that a different result was to be hoped for, especially remembering that when the air was cool and the general atmospheric conditions bracing, the Fund as a rule did not thrive heartily. It was confidently held that, when the Chicago Companies placed their names on the list for a good round sum, the other Western Companies, and, in fact, the Eastern ones that were not pledged, would respond generously to the appeal of the Council; but in the current illumination of the subject this confidence was not soundly based. For instance, the annual meeting of the St. Paul (Minn.) Gas Light Company was held in this city, on the morning of July 20th, and although the proceedings were directed by a man well known for his liberality—Mr. Henry Villard—and despite the fact that the Company has always been managed in an admirable businesslike way, the meeting adjourned without having made any subscription to the Fund. It may be, and we are more than inclined to such a view, that the matter was overlooked; and in such event the lack of action may be easily remedied. It is an open secret now that the Consolidated Company, of this city, is willing to subscribe $5,000 to the Fund, provided the ultimate sum of $125,000 is pledged; or, we may say that when $120,000 is raised, the Consolidated Company will bring the Fund to the required limit. It seems to be superfluous to return to or make further expression of arguments showing the good policy of subscribing to the project of the Gas Industry Council. The Associations, many of the manufacturers of appliances, men of the stamp of Mr. Pearson, of Toronto, and the JOURNAL, have time and again urged the subscription on the ground that those who subscribe are merely investing money that is sure to be returned to them with good interest in many ways. The beneficial effect on the gas industry at large, of a display of the nature contemplated by the Council, cannot be overestimated; and, again, should the display be not carried out, we fear that the industry at large will suffer materially from the failure. We do not, however, believe that failure is to be the end of this movement, although possibly the exhibition may not be brought off on the grand scale originally proposed. Nor is it vitally necessary that it should be. What the interest requires at the World's Fair is separate, individual representation; and we think all will coincide in this. If so, we can only repeat our former expressed hope, made more than once, that the Council will eventually determine to, even if the maximum amount of $125,000 is not in sight at a certain specified time, do the best it can under the circumstances, and have such an exhibition as the means at its command will permit. During the week but one subscription has come to hand, and although it is not large in amount, nevertheless it is warmly received, in that it comes from a Company away in the great Southwest, whose proprietors thus give evidence of their fraternity. This subscription would have been published in the earlier lists for July were it not for the fact that it had been misdirected. The following is the state of the subscription, up to the evening of July 27th:

July 5.	The Dallas (Tex.) Gas and Fuel Co	$25 00
	Amount previously published	66,555 28
	Grand total (to July 28)	$66,580 28

BRIEFLY TOLD.

THE JULY OUTING OF THE GAS CLUB OF CHICAGO.—We are indebted to "C. H. D." and to "Western Observer" for particulars respecting the July outing of the Gas Club of Chicago, from which we learn that, as usual, those who participated in the jaunt were "very glad they came." At the outset, things looked blue, in that economic Yuille and the energetic Shelton, to say nothing of the ubiquitous Bradley, were not to be of the party—business detained them in the city; and it may be taken for granted that it was pressing business alone that could keep them off the Lake on a day the temperature of which in the city was next to insupportable. However, some amends for their defection came in the shape of three substitutes, who were heartily welcomed. There was Ramsdell, the brown-eyed, William McDonald, the urbane—note the propinquity of the pair—and Mr. J. J. Humphreys—a third one of the well-known Humphreys' family. At 8 A.M., as the steamer Virginia glided from the pier, a count of noses showed that 20 members of the Club would sniff the breezes off the unsalted seas. A most delightful rocking on the "said unsalted" brought calm to many minds, and the ease of the trip developed the fact that the Club boasts of many "awful"—good story tellers. A good dinner came apace, and it was waisted, not wasted. About 4 P.M. the Virginia landed at Milwaukee, and amongst those at the shore end of the hawser were Messrs. Cowdery, Bredel and Dickey. In fact, we believe that Bredel, whose seagoing qualities are well-known, took in the slack. At Milwaukee the first thing to follow the greetings was an inspection of the gas plant. Messrs. Kremers and Cowdery, ably assisted by seaman Bredel, brought the visitors over the premises, and as we have called it a model plant at least a dozen times in the last year, we have only to remark now that it is "modeller" than ever. In fact, its completeness goes far to show why it is that Cowdery can enrich his Directors by selling fuel gas at 80 cents per 1,000. No wonder the syndicate offered that big price for control of the Milwaukee stock recently; further, the same conditions do away with any wonder over the refusal on the part of the present owners to accept the aforesaid "big price." The inspection completed, the Club, its guests and entertainers were called on to "absorb" a well-arranged lunch, which they did without complaining. The menu card was an odd device, and the list, from "Crushed Coke" to "Cannel Coal in Sticks," evidently gave the satisfaction of its promises; for at the end not even a portion of the "Bi-Sulphide of Carbon" was left to reveal what that ill-smelling title stood for. Ah! for the famous beer of Milwaukee's famous breweries—on that occasion only it masqueraded as "Ammoniacal Liquor"—undoubtedly a baptismal appellation devised by Bredel. The early evening hours sent the boys to the boat—scarcely any returned to Chicago by the trains—and midnight still found some of them enjoying the night lights of nature, the crooning of the waters, as the Virginia cleft her way through them, and their own recounting of the pleasant hours that compassed the July outing of the Gas Club of Chicago.

ANNUAL MEETING OF THE NASHUA (N. H.) LIGHT, HEAT AND POWER COMPANY.—At the Annual Meeting of the Nashua Company the following officers were chosen: Directors, Dr. Edward Spalding and Messrs. C. H. Nutt, J. H. Tolles, F. E. Anderson and F. W. Estabrook; President, F. W. Estabrook; Clerk, J. H. Tolles; Treasurer, F. E. Anderson; Supt. Gas Department, Fred. W. Norton; Supt. Electrical Department, G. L. Sadler. The Directors adopted the following resolution expressive of their regret at the death of Mr. A. M. Norton:

Resolved, That by the death of our Treasurer and Superintendent, Mr. A. M. Norton, this Company has lost a highly esteemed and efficient officer. Mr. Norton came to Nashua in April, 1874, and was appointed Superintendent of the Nashua Gas Light Company. He had continued in the office to the time of his death, a period of 18 years. During this long service the business of the Company was greatly enlarged by the use of gas for heating and other purposes, the consumption of gas being increased from 10,483,410 feet, in 1875, to 33,937,680 feet, in 1892, notwithstanding the introduction by the city of electricity for illumination. Under his able management the Company has been unusually and uniformly prosperous. We desire to put on record our high appreciation of Mr. Norton as an officer of the Company and of our great respect for him as a gentleman whose courteous and friendly bearing rendered our official relations harmonious and our personal intercourse always agreeable.

THE Huntington (W. Va.) Gas Company, the Huntington Electric Light and Street Railway Company, and the Belt Line Street Railroad Company, have consolidated their interests. The City Council has also extended the franchises of all the Companies for 40 years.

A Century of Work on the Development of Light from Coal Gas.

[The "Murdoch Memorial Lecture," delivered by Prof. Vivian B. Lewes, F.I.C., at the Meeting of the Incorporated Gas Institute.]

The hundred years which have elapsed since Murdoch made his greatest discovery, and illuminated his house at Redruth with coal gas made in an iron kettle, have taught us many lessons; and by no means the least important chapter in the history of this century is the rapid growth in our methods, not only of making gas, but of burning it. In spite of all that has been learned, however, we are only on the outskirts of a real knowledge of the changes which give us our great gaseous illuminant; and although a century of experiment has taught our gas managers the best coal to use, and the best methods and temperatures for producing gas from it, we are still ignorant of the exact nature of the hydrocarbons present in the coal, which, under the influence of destructive distillation, yield the gas, and also of the changes which result in the complex residue we know as tar, and the gaseous mixture which forms the coal gas itself. The questions still to be answered with regard to coal gas will take long years of research for their elucidation; and I propose to-day to devote myself to the discussion of the methods we employ for the generation of the light from the gas, and to the facts we have learnt as to the causes of luminosity in flames, rather than to trespass upon a subject which still contains so many unknown factors.

When Murdoch, in 1792, first made coal gas in his Cornish home, he burnt it as it escaped from the open end of a pipe; but, quickly perceiving that a spreading of the flame gave a better light with a decrease in consumption, he fitted a thimble over the end of his tube, and, by boring small holes in the thimble-head, caused the gas to burn in several small jets. But as his experiments progressed, the form of his burner was modified, until in 1807, when fitting up the works of Messrs. Phillips & Lee, in Manchester, he used two forms of burner—the one a rough argand, and the other "a small curved tube with a conical end, having three circular apertures or perforations, about a thirtieth of an inch in diameter, one at the point of the cone, and two lateral ones through which the gas issued, forming three divergent jets of flame somewhat like a fleur-de-lys."* This latter burner, which, from the shape of the jet, received the name of the "cockspur" burner, gave a light equal to 2¼ mould candles of six to the pound; while the argands used developed a light equal to four candles of the same description. The argand burner had been in use for the consumption of oils for some years before the introduction of coal gas; and in its early form consisted simply of two concentric tubes fixed at the required distance apart; the coal gas being fed in between them. Soon, however, the idea arose of closing the open circular slot by a metal ring pierced with holes so as to give a circle of small jets; and even prior to 1816 the main principles of our present argands were to be found in the burners in use. It was about 1816 also that the cockspur burner became converted into the cockscomb, and then the batswing—thus marking a distinct advance in the method of burning the gas, as by spreading the flame out into a thin sheet, instead of having it in a solid mass as in the jet burner, the air was more uniformly and readily supplied to the burning gas, and the increased temperature of the flame, due to the more perfect combustion, increased the light-giving power of the burner to nearly that of the argands then in use.

In 1820, Neilson, of Glasgow, whose name will always be remembered as the discoverer of the hot blast in iron smelting, found that, by allowing two flames to impinge upon each other, an increase in luminosity was obtained; and, after several preliminary stages, the union jet or fishtail burner was produced, in which two holes bored at the necessary angle in the same nipple caused two jets of gas to impinge upon one another, so that they mutually splayed themselves out into a flat flame. The shape of the batswing flame was a very wide flame of but little height, while the fishtail flame was much higher and narrower; and although the service yielded by the fishtail for each foot of gas consumed was no better than, if it was as good as, that given by the batswing, yet its shape, which made it less affected by draughts, and enabled a globe to be used with it, ensured a greater meed of success for it than the batswing burner had secured.

The next twenty years was a period of improvement and gradual perfecting of the argand and flat-flame burners—the influence of pressure and regulation of the flow of gas to the burner being gradually realized and arranged for; whilst other structural improvements were introduced later by Sugg, Bray, and others.

In the year 1854 a new and important departure was made by the Rev. W. R. Bowditch, who conceived the idea of utilizing heat, which

* Murdoch's Royal Society Paper, 1808.

otherwise would have been lost, to raise the temperature of the air supply, by enclosing an argand burner by a double glass cylinder so arranged that the air had to pass down between the glasses and in its passage become highly heated. The burner itself was never a commercial success, as the high temperature so rapidly acted upon the inner glass as to render its frequent renewal necessary; but it marks an important era in the history of lighting by gas, as in it we find the inception of the regenerative lamps which during the last 13 years have revolutionized the methods for the production of high illuminating values from gas. The first successful application of the principle was by Mr. F. Siemens, in 1879. The results he achieved were so far in advance of any previously obtained that others followed in his footsteps; and Clark, Grimston, Bower and Thorp all contributed burners in which the same principles received slightly different application. These in turn have given rise to the host of others which not only add to our power of illumination, but also threaten to increase business in the law courts.

About the same time that the regenerative burner was struggling into prominence, Mr. Lewis brought out a burner in which the coal gas was consumed mixed with air, as in a Bunsen burner; and the flame was then urged, by an artificial blast, against a cone of fine platinum wire, which being heated to incandescence gave a very high candle power per cubic foot of gas consumed, and was thus the forerunner of the Welsbach, Clamond, and other incandescent lights.

Having traced the gradual genesis of our present burners, we must now glance at the theories which have been from time to time advanced as to the causes that endow a flame containing those compounds which we know as hydrocarbons with the properties of emitting light; for, until we have some conception of the causes which give rise to luminosity in a flame, it is impossible to arrive at any idea of how far further improvements may be expected to go, and in what direction to look for them. While this century was still in its "teens," Sir Humphrey Davy undertook that great research which culminated in the invention of the Davy safety lamp; and during this work he made some observations which caused him to enter upon further researches as to the cause of luminosity in flames. These were embodied in his historical papers published in the Transactions of the Royal Society for 1817. These researches led him to the conclusion that the luminosity of flames is due "to the decomposition of part of the gas towards the interior of the flame, where the air is in smallest quantity, and the deposition of solid carbon, which, first by its ignition and then by its combustion, increases in a high degree the intensity of the light." Davy's explanation remained unquestioned until 1868, when Dr. Frankland showed that flames such as that of hydrogen in oxygen could be rendered luminous by compressing the oxygen, and that such a flame contained no solid particles, as required by Davy's theory; also that the intense light emitted by phosphorus burning in oxygen, or arsenic in oxygen, could not be due to this cause, as the temperature of the flame was higher than the volatilizing points of the products—phosphorus pentoxide and arsenious trioxide. The combustion of phosphorus in oxygen, for instance, gives a temperature of over 1,300° C.; while the oxide that is formed volatilizes at between 800° and 900° C.

Dr. Frankland's research showed beyond doubt that a flame containing dense vapors might be luminous; but he failed in proving, as he claimed, that the luminosity of a coal gas flame was due to dense hydrocarbon vapors heated to incandescence, and not, as Davy had stated, to separated carbon particles at a high temperature. This paper gave rise to a large number of other researches and communications on the subject, which greatly increased our knowledge of the actions going on in flames and the various causes which affect them. Dr. Frankland not only showed that flames might be luminous without containing solid particles, but advanced the theory that the luminosity in the flame of a burning gaseous hydrocarbon was due to dense hydrocarbon vapors; and he further pointed out that the soot deposited upon any cool substance held in such a flame contained hydrogen. To this W. Stein replied, showing that the deposited soot contained less than 1 per cent. of hydrogen, which was therefore probably only occluded by the carbon; and also that, if it had been present as a vapor in the flame, it ought, on being heated to the same temperature as the flame, to be once again volatile, which it undoubtedly is not. In the year 1874, Soret attempted to show that the cause of luminosity in flame really does depend upon the presence of solid particles, by focussing the sun's rays upon a luminous flame, and examining the reflected light by means of a Nicol prism. Rather later, Burch pursued the same line of research, but he employed the spectroscope for his examination of the reflected light; while quite lately, Professor Stokes, following the same line of research, has confirmed their results, all of which point conclusively to the presence of solid particles in those flames which owe their luminosity to the combustion of hydrocarbons. Heumann also, in 1876, pointed out that hydrocarbon flames gave a distinct shadow, which is only the case when solid particles are present.

It is impossible to gainsay or refute the mass of evidence which has been adduced upon this point; and we must accept as proved beyond doubt that the luminous portion of hydrocarbon flames contains solid particles of practically pure carbon, which, partly by their own combustion and partly by the combustion of the other gases present, are heated to incandescence, and contribute at any rate a very large proportion of the luminosity of the flame. In the present state of our knowledge, I should be sorry to say that the luminous portion of a flame does not contain some extremely heavy hydrocarbon vapors, and that these may not, under the influence of intense heat, add to the general effect. But at present I have been unable to detect their presence, while the presence of solid particles has been abundantly proved. Several attempts have been made to trace the chemical changes going on during the combustion of the flame gases. Hilgard, Blochmann, and Landolt did this by withdrawing portions of the gases from different parts of the flame, and analyzing them; but no definite conclusion was arrived at as to the actions which culminated in the liberation of the all-important carbon particles. For some time past I have devoted attention to this point, and, with the aid of my assistants, have, I think, found the key to the actions which are going on within a luminous flame—actions far more complicated than were imagined or provided for by the older theories, and yet in themselves beautifully simple.

In our coal gas, we have a mixture of hydrocarbon gases and vapors diluted with hydrogen and small quantities of carbon monoxide; while such unwelcome impurities as carbon dioxide, nitrogen, and oxygen also exist in traces as small as the gas manager's skill can make them. The composition of coal gas varies considerably with the temperature at which the retorting of the coal takes place; and the gas made by one company may vary from time to time within fairly wide limits. The composition of the London gas at the present time is a study of considerable interest, as it reveals occasionally signs of the methods of enrichment which are being tried at some of the principal works:

South Metropolitan Gas.

	1890.	1892.
Hydrogen	57.08	52.22
Unsaturated hydrocarbons	4.38	3.47
Saturated hydrocarbons	33.99	33.76
Carbon monoxide	2.63	6.23
Carbon dioxide	0.79	0.60
Nitrogen	0.96	3.23
Oxygen	0.15	0.49
	100.00	100.00

In all our gas flames we can trace by the eye two principal zones, and at least one subsidiary one. There is the non-luminous zone just above the burner, and above it again is the all-important area of luminosity which gives the value to the flame; and between this and the air comes a thin non-luminous mantle which marks the confines of the flame. The inner non-luminous zone of the flame has always been looked upon as the zone of non-combustion, and but little attention has been paid to it by the chemist; while the gas engineer has often yearned to decrease its size, and so increase the zone of luminosity, but has so far found that regeneration is the only practical method of doing so. If we are to increase the amount of light which it is possible to obtain from a gas flame, it is manifest that this portion of the flame offers us the most promising field for research. My experiments upon flame gases show that as the coal gas comes from the burner into the air, the hydrogen, on account of its lightness and diffusive power, finds its way to the exterior of the issuing gas, and burns first; combining with the oxygen of the air to form water vapor. Next in order of rapidity of burning is the methane, or marsh gas, which is also the lightest gas, next to hydrogen, present. The hydrogen in the marsh gas burns to water, while the carbon burns partly to carbon dioxide and partly to carbon monoxide, according as the marsh gas molecule at the moment of combustion is in an excess or deficiency of air. The carbon monoxide is generated in the flame, partly by incomplete combustion and partly by the action of water vapor on some of the heavy hydrocarbons, so much more quickly than it is burnt, that it increases in quantity up to the top of the non-luminous zone, although itself a combustible constituent of the gas.

The combustion of these two gases on the exterior of the lower portion of the escaping coal gas creates intense heat, and bakes the remaining portions of the gas in the non-luminous zone; and this causes important changes to take place in the heavier saturated and unsaturated

hydrocarbons present. These consist chiefly of ethylene, benzene, propylene, butylene and crotonylene, as representatives of the unsaturated hydrocarbons; methane, ethane, propane and probably butane, as representatives of the saturated. With the exception of the methane, these hydrocarbons are all of considerable density; and the denser they are, the smaller is their tendency to find their way to the exterior of the flame. Only the straggling molecules from their ranks do this; so these bodies decrease far more slowly in the earlier portion of the flame than the lighter gases with which they are mixed. These hydrocarbons, however, are gradually altered by the heat to which they are subjected; and they all show a tendency to break up into acetylene at a temperature a little over 1,000° C. (2,120° F.), so that by the time the top of the non-luminous zone is reached, 81 per cent. of the still existing hydrocarbons have been converted into this body, and the luminosity of the flame commences immediately afterwards. Acetylene is a clear, colorless gas, with a strong and disagreeable odor. It consists of 24 parts by weight of carbon, combined with 2 parts by weight of hydrogen. It is one of those bodies which during their formation take in heat instead of giving it out, and it is therefore called an "endothermic" compound. Such substances are especially liable to decomposition, as this is accompanied by a rise in temperature instead of, as is the case with most decompositions, an absorption of heat. Acetylene is decomposed at between 1,100° and 1,200° C. into carbon and hydrogen, together with traces of higher hydrocarbons; while Berthelot has shown it to be so unstable that it can be broken up into carbon and hydrogen by detonating a percussion cap in it.

The next step in elucidating the cause of luminosity was to determine the temperature existing in the various parts of a flame; and as a flat flame offers a more convenient surface for research than any other, the flame from a No. 7 Bray burner was chosen, and the temperature of the various portions was determined by a Le Chatelier thermo-couple. This consists of a piece of platinum wire, the end of which is twisted with the end of a wire made of platinum with 10 per cent. of rhodium. On heating this, a galvanic current is generated, which is made to pass through a reflecting galvanometer of special construction, and this deflects the needle. A ray of light falls upon a mirror attached to the needle, and is reflected on to a scale; so that, as the needle moves, a spot of light travels along the scale. The scale is graduated into degrees by plunging the thermo-couple into various media the temperature of which is known; and as the current generated is practically proportional to the temperature, it makes a very convenient arrangement for measuring high temperatures.

Using this instrument, it was found that the temperature half an inch above the burner was 500° C. (932° F.), and steadily increased to 1,200° C. (2,192° F.) at the top of the non-luminous zone, luminosity commencing at 1,200° C. (2,192° F.). The highest temperature was found to be near the top of the luminous zone, where it reached 1,368° C. (2,462° F.). In no case is the temperature of the luminous portion of the flame less than from 1,100° to 1,200° C.

Taking the evidence which I have now laid before you, we may, I think, fairly fully explain the actions that take place in the flame, and lead to luminosity. As the gas leaves the jet, the hydrogen rapidly diffuses to the outer edge of the flame, and burns; the methane doing the same, but rather more slowly. The combustion of these gases raises the temperature 500° C. in the first half inch; while before another half inch has been traversed 1,000° C. is reached, and the chemical changes in the hydrocarbons are progressing rapidly—the unsaturated hydrocarbons and higher members of the saturated hydrocarbons being rapidly converted into acetylene. If the temperature of the flame were not allowed to rise above 1,000° C., this acetylene would be nearly all polymerized into benzene, naphthaline and other more complex bodies, which would be slowly burnt up without liberation of carbon, and a non-luminous flame would result. This may be shown by holding a platinum dish against a luminous flat flame, when luminosity disappears; but it may be reproduced by heating the interior of the dish. In the case of a gas flame, however, instead of remaining at 1,000° C., the temperature rapidly rises to 1,200° C., with the result that, instead of polymerizing into more complex bodies, the acetylene formed at once splits up into carbon and hydrogen, and the former, heated to incandescence by combustion, gives the luminosity. It is the attainment of this temperature that marks the limit of the non-luminous zone. If this were the only action, however, the luminous zone would be very short. But the bodies formed from the acetylene before 1,200° C. was reached, and the methane, of which some still remains unburnt, are converted into acetylene at a still higher temperature—*i. e.*, 1,300° C.; and this being reached near the top of the luminous zone, yields a fresh supply of carbon, and so increases the height of the light-yielding portion of the flame.

In producing the luminous flame, therefore, there are two main factors to be observed—first, to use such compounds as shall be most easily converted into acetylene; and, secondly, to attain as quickly as possible as high a temperature as practicable. The moment we have reached this point in our theory, we naturally think how this can be best done; and we find to our disgust that theory has only just caught up practice, as long experience has taught our gas managers that the olefines and unsaturated hydrocarbons are the most valuable illuminants in the gas, while our burner makers have slowly and by laborious steps found that by regeneration they can obtain the best results per cubic foot of gas consumed.

Some of my hearers will go beyond this point, however; and it may flash through their minds to ask: "If acetylene is the key to luminosity, and if this gas is formed by the action of high temperatures on the gas, why is it that retorting at high temperatures gives but a trace of acetylene and ruins the illuminating power of the gas?" Simply because the heat which forms the acetylene also polymerizes that body into benzene, and still more largely into naphthaline, especially in the presence of carbon; and you know better than I do that high temperatures result in an increased yield of this body, or else, having formed acetylene, breaks it down to carbon and hydrogen, and that any attempts to increase the luminosity by superheating the gas must end in failure, as the action taking place in the flame is probably the only method by which this body can be so formed as to yield the desired results. In the flame it is formed and at once decomposed by the heat of combustion; in the retort it is formed at high heats, and yields but traces of benzene and naphthaline, which largely go into the tar, or condense where they are least wanted. Even if it were possible to charge gas with acetylene, it would be useless for practical purposes, as it is soluble in water and all other media, such as glycerine, which could be used in gasholders and meters. So that once more we come back to the fact that, in our gas flame, nature has provided the best methods for the carrying on of the actions which culminate in luminosity, and that the most likely field for improvement is in our mechanical treatment of the flame itself. This is also shown by the fact that in an ordinary gas flame the luminosity is caused by something like 1.5 per cent. of acetylene liberated at the right spot; whereas double this quantity, mixed with a non-luminous gas like hydrogen, yields hardly any light-giving power to the flame, because by the time the temperature necessary for the splitting up of the acetylene is reached, it is nearly all burnt up without any liberation of carbon.

Regeneration, as has been before pointed out, increases to a very great extent the light yielded per cubic foot of gas. This is due to two causes. In the first place, by increasing the temperature, the decompositions necessary to form acetylene and liberate carbon from it are hastened, and so the non-luminous zone is decreased in size, and a larger proportion of the gaseous hydrocarbons are converted into acetylene; and, secondly, by heating the inert nitrogen of the air supply, it prevents the withdrawal of so much heat, and raises the carbon particles, when liberated, to a brighter incandescence, and so yields a higher service. Through the kindness of Mr. Siemens I have been enabled to determine the effect of regeneration on a flat flame, both as regards the diminution in size of the inner zone and the increase in luminosity. The flame, when cold, had a total area of 11 square inches, of which the luminous zone occupied 7.8 square inches and the non-luminous 3.2 square inches. On regenerating this flame, the total area decreased to 10. 2 square inches; but the luminous zone occupied 7.9 square inches and the non-luminous zone 2.3 square inches of the space; while the illuminating power was increased 100 per cent.

The regenerative gas burner, however, is by no means the most widely used one; and initial cost and domestic inertia are such all-powerful factors that the flat flame burner is still the burner of the people. But great as have been the improvements effected in this class by our leading makers, the use of the flat flame burner means several millions wasted annually—not to the profit of the gas manager, but simply in loss of light to the consumer; and as anything which could be done to increase the light-giving power of the flat flame would be an inestimable boon, you will pardon my spending a few moments in pointing out a direction in which, I think, attempts might be made to do this. In the passage of the heavy hydrocarbons up the non-luminous zone of the flame, a certain percentage must of necessity be lost by wandering into the part of the flame where combustion is taking place, and where they get burnt up without decomposition, and so are lost as far as any luminosity is concerned. The larger the inner zone, the greater will this loss be; so that if the inner zone can be by any means reduced in size, not only do we gain an increase in luminous surface, but a larger supply of carbon particles to yield light.

Some five-and-twenty years ago a device for increasing the luminosity

of a flat flame, called "Scholl's platinum light perfecter," created a considerable amount of interest; and undoubtedly, while the perfecter was new, it caused a considerable increase in the amount of light emitted by the flame. The perfecter consisted of a thin slip of platinum fixed across the burner, and between the orifices of the jet, so that the two streams of gas impinged upon it, and afterward mingled in the flame. The explanation always given of its action was that, in the far from perfect burner then in use, it perfected the combustion of the flame by breaking the rush of the gas; and that, had it been applied to a properly regulated burner, no gain would have resulted. This view is, to a great extent, supported by the effects of pressure upon the gain in light obtained by its use, as Mr. Rowden and Captain Webber found that the increase in light given by it varied from 30 per cent. with a pressure of 0.46 of an inch, to upward of 200 per cent. with a small burner and a pressure of 0.84 of an inch. But although this was an important factor, a still more important one remained; and that this was so is shown by the fact that, after being used for a considerable time, the perfecter lost its power to a very great extent, which would not have been the case had its action been purely mechanical.

Platinum is a metal which possesses the property of condensing gases upon its surface, and rendering them chemically more active than when in their normal condition; so that if the condensed gases have a tendency to enter into chemical combination, the presence of the metal, especially when heated to a certain extent, will set up chemical action. That this is the case is clearly shown by heating a piece of platinum foil to redness, allowing it to cool until it ceases to be visibly hot, and then holding it in a current of mixed coal gas and air, when the metal at once becomes red hot, and often reaches a temperature at which the gas is ignited. This is due to its compressing the oxygen of the air and the hydrogen of the coal gas upon its surface, and bringing about their combination—an action which evolves great heat and raises the platinum to incandescence, although the actual temperature necessary to ignite the gas may not be reached, as the heat required to do this is very great. In the perfecter the strip of metal, besides regulating the force with which the two streams of gas impinged upon each other, was raised by this action to incandescence in a portion of the flame which otherwise would have been several hundred degrees cooler, and thus converted the hydrocarbons into acetylene, and by its superheating action reduced the size of the non-luminous zone. After a time, however, the platinum became attacked by the hydrocarbons of the gas, and the carbide of platinum formed ceased to have this regenerating action, and the perfecter lost its potency. It was this deteriorating action of the coal gas on platinum which I believe seriously militated against the success of the Lewis incandescent lamp, which was undoubtedly the most promising of its class, but which, for the reason I have given, soon lost its power.

By placing a platinum wire in the non-luminous zone of a flat flame, we can, if care is taken not to distort the flame, draw down the luminous zone to a considerable extent; and if a fine platinum gauze screen be placed on each side of the lower portion of the non-luminous zone, it acts in the same way as regeneration does, and gives a considerable increase in luminous surface. Another way in which the non-luminous and non-effective portion of the flame may be reduced is by increasing the rate of combustion at the bottom of the flame. Ten years ago Sir James Douglass introduced his multiple argand, in which a number of circular flames burnt one within the other, while a series of deflectors caused a sharp current of air to impinge upon the outer flames at their base, causing a very great increase in the illuminating effect produced per cubic foot of gas consumed. In this burner the outer layers of flame were sacrificed to create an intensity of temperature which should perfect the light-giving power of the interior layers; and by setting up this intense combustion at the base of the flame, the service of the burner was raised to 6 candles per cubic foot of 16-candle gas. A still better example, because more widely known, of the same thing is to be found in Mr. Sugg's "London" argand, in which the metal cone round the burner plays the same part as the deflectors in the Douglass burner, although to a smaller degree, while the cluster burners also benefit to a certain extent by the increase of temperature which their arrangement brings about; and I cannot help thinking that if our burner makers will attack the question of improving the flat flame by thickening the flame a little, and introducing a suitable form of deflector to bring a current of air against the base of the flame, we shall soon be able to squeeze a couple of candles more service out of these trusty old servants, and thus add an iota more cheerfulness to our gas-lit cities.

The question of how far it may be possible to go in the extraction of light from gas is a question so complex that I hesitate to even mention it; but I think that many things point to the best forms of regenerative burner having nearly reached the limits of practical possibilities. So that, in conclusion, it may be well to see in what other direction the development of light from coal gas may yet extend. The 4 per cent., or thereabouts, of heavy hydrocarbons, which in the ordinary combustion of coal gas yield the acetylene necessary for the liberation of the carbon particles which are essential for the production of luminosity, are so small in quantity, as compared with the constituents which in the burning of flame merely generate heat, that the idea naturally arose of the incandescent burner, in which, by the admixture of air with the coal gas before combustion, a non-luminous but hotter flame could be produced and utilized for heating various refractory materials up to incandescence, so that they, and not the carbon, should emit the light. In burning coal gas from an open tube, the highest temperature attained is about 1,100° C. (2,012° F.); while in the more perfect combustion taking place in a flat flame, 1,368° C. (2,462° F.) is attained. But by mixing air with the gas before combustion, as in the ordinary Bunsen burner, until the mixture burns with a quiet and non-luminous flame, a temperature of 1,500° C. (2,732° F.) is reached; while by increasing the quantity of air until the flame is on the point of flashing down in the tube, the temperature rises to 1,630° C. (2,966° F.), or nearly 300° C. hotter than the luminous flat flame. It is this high temperature which is taken advantage of to raise the various materials used in incandescent burners to the point at which they emit the required light.

In order to gain a relative idea of the service obtained per 5 cubic feet of 16-candle gas from the various classes of burner, choosing the best of each kind for comparison, we may take it (roughly) as being as follows:

Service Yielded by Various Burners per Five Cubic Feet of Gas per Hour.

Flat flame	12.5
Argand, ordinary	14.0
London argand	16.0
Regenerative	52.5
Incandescent	70.0

A colleague of mine at the Royal Naval College—Professor Lambert—has been for some time past experimenting in his own house as to the cost of various forms of illuminating on a domestic scale; and his results, for actual working over a considerable period, he has kindly placed at my disposal. They are as follows:

ANNUAL COST OF MAINTAINING A LIGHT OF 48-CANDLE POWER (SAY 2,000 HOURS' BURNING).

Results of Tests Under Practical Conditions.

GAS.

Argand Burners.—Three 16-candle lamps, each consuming 5 cubic feet of gas per hour—

30,000 cu. ft. of gas, at 3s. per 1,000 cu. ft.	90s.	
Renewals of chimneys	3s.	
		93s.

Regenerative Burner.—One small lamp, consuming 6 cubic feet of gas per hour—

12,000 cu. ft. of gas	36s.	
Repair of lamps, etc	5s.	
		41s.

Albo-Carbon Burners.—Two No. 2 Bray burners, each consuming 3½ cubic feet of gas per hour, carbureted with naphthaline—

14,000 cu. ft. of gas	42s.	
52 pounds of naphthaline, at 3d	13s.	
		55s.

Incandescent Burner.—One new large mantle, 48-candle power, burning 3½ cubic feet per hour—

7,000 cu. ft. of gas	21s. 0d.	
Renewal of mantles, 3 at 2s. 6d	7s. 6d.	
Renewal of chimneys	1s. 6d.	
		30s.

PETROLEUM.

Large Lamp.—One 48-candle lamp, burning one gallon of oil in 28 hours—

Oil consumed, at 7d. per gallon	41s. 8d.	
Chimneys, wicks, etc	2s. 4d.	
		44s.

Small Lamps.—Four 12-candle lamps, each burning one gallon of oil in 84 hours—

Oil consumed	55s. 6d.	
Chimneys, wicks, etc	2s. 6d.	
		58s.

ELECTRIC.

Incandescent Lamps.—Three 16-candle incandescent lamps, each absorbing 56 Watts—

Cost of current, at 8d. pr. unit (1,000 Watt-hours)	224s.
Lamp renewals, 6 at 3s. 6d.....	21s.
	245s.

The only remark which I have to add to this particularly interesting and useful table is that Professor Lambert has been extremely fortunate with his incandescent mantles and chimneys; while the regenerative lamp employed is manifestly too small to give anything approaching its maximum results. My own experiments would lead me to say that the incandescent and regenerative burners, taking everything into consideration, are as nearly as possible equal in cost; each of them yielding the above amount of light for an expenditure of about 35s.

In the search, moreover, for the best method of generating light from coal gas, we must not overlook the quality of the light emitted. We should remember that the yellow light given out in the ordinary consumption of coal gas is eminently adapted for resting the eye, wearied by the actinic rays of the daylight; and that, although an intense white or bluish-white light is admirably adapted for picture galleries and other situations where it is necessary to bring out delicate shades of color, yet that in the living and working room such a light must in time affect the eyesight more or less. Incandescent lighting is still in its infancy; and it has yet to be discovered how to make a mantle or cone which will not deteriorate in use, and shall not be too brittle to withstand the jars of everyday work.

I have in this lecture attempted to place before you a general outline of the wonderful growth of our present methods for developing light from coal gas; and we may well be proud of the results of the work done in the past century. But is there no reverse to this picture? Has everything been done which might have been done to encourage and increase the demand for gas? The gas engineers and managers of this country may have been a little tardy in recognizing new principles; but their record is a noble one, and the one great mistake of the century does not rest upon their shoulders. For coal gas to take its proper place, it must be supplied at the cheapest possible rate; and all statistics show that the increase in consumption when the price of gas is low is very large indeed. The one thing which has more than anything else kept back the gas industry has been the fixing of the illuminating value at too high a figure. If a 14 instead of a 16 candle standard had been adopted here in London, an almost unbearable burden would have been taken off the gas manager's shoulders. Not one consumer in a thousand would have noticed any difference in the light—indeed, a little trouble on the part of the Companies in advising consumers as to the best forms of burners to use, would probably have resulted in an absolute gain; while the reduction in price consequent on the doing away with the need of enrichment would have given an enormous impetus to the employment of gas as a domestic fuel.

Inconsistencies of Organized Labor.

"B. F. T.," in the *Iron Age*, makes the following excellent remarks respecting the question designated in the title:

The ostensible and avowed object of labor organizations is, primarily, the protection of the rights of working men and women against the alleged oppression by their employers, upon the hypothesis that labor and capital were essentially antagonistic, and that as capital was so much more powerful than individual labor, the only way in which the latter could hope to successfully maintain its "rights" was in organization. That is, by combining the many individuals into a unit, of whom the capitalist must buy the labor required in his business, or go without, it must necessarily reverse the previous order of things, and place the preponderance of power in the hands of the workman. This Utopian idea had the weakness of being illogical and impracticable, though the influence of the movement has been so far-reaching as to have been felt in every portion of the civilized world, and the end is not yet.

Divested of all sentimentalism the subject may be resolved into an abstract question of political economy, the pros and cons of which should be considered dispassionately, if logical conclusions are to be reached. It is needless to say that any attempt to interfere with normal conditions, in any connection, must result in disturbance and confusion. And even if the effort is successful, and a radical change effected, the natural tendency toward a return to the normal would necessitate constant tension in order to maintain the changed conditions. Sooner or later the temporary character of the change is manifested by a readjustment upon the original basis. Given sufficient velocity of current we may cause water to flow (?) up hill for a certain distance. But the least reduction of the velocity will correspondingly shorten this distance, and if removed entirely an immediate return to its natural level will result. What is the analogy? Considered in its true light, the labor question is not between capital and labor, but the relation between supply and demand. Labor is a marketable commodity—quite as much so as wheat, which is simply the result of the farmer's labor; the workman is the seller and the manufacturer or capitalist the buyer. Under normal conditions, if the demand for labor is great in proportion to the number of available workmen, wages must go up correspondingly. If, on the contrary, the number of men seeking employment is in excess of the demand for their services, the natural consequence will be a reduction in the price of their labor. In the first case the competition is between the employers, in the latter the workmen.

The manufacturer must have the services of the workman, or he will be unable to carry on his business. The workman must have employment in order to earn the living for himself and family. The principle difference between the two is that, while the loss or stoppage of his wages is almost a matter of life or death to the latter, to the former it is not nearly so desperate, but merely an interference with his commercial prosperity. So far, then, the advantage is clearly with the employer. It may be said that the employer has it in his power to fix arbitrarily the rate of wages he will pay, regardless of any other consideration than his own will and pleasure. Let us see. If trade is brisk and the demand for labor great in proportion to the available number of workmen, the manufacturer must offer some special inducement to the former to work for him, otherwise he will be unable to obtain the number necessary for his business, or at least he can secure the services of only so many as cannot find employment with the other manufacturers who are paying a higher rate of wages. In other words, while the effort is always to buy as cheaply as possible, the law of supply and demand is the only power in existence which can fix the values of commodities, whether they be merchandise or labor. The employer is quite as much subject to this law as the employee—he must pay the market price of labor, as the workman on his part must accept it, whether it be high or low; and neither has any more cause for dissatisfaction than has the farmer selling his labor products, or any other laborer who sells the product of his labor instead of the labor itself. And yet there is no idea of antagonism between the farmer and the miller, for instance, who buys his wheat. He realizes that the miller does not have it in his power to make the price of wheat any more than does the employer that of labor. Wheat must be cheap if the supply is great in proportion to the demand—under normal conditions, of course—and the producer, even if he indulges in some grumbling at the state of affairs, does not feel aggrieved that it exists.

One of the fundamental principles of the so called rights of labor is the absolute right of every man to sell his services to the best advantage to himself. This is but logical and right. It makes the skillful and industrious workman capable of earning in proportion to his degree of superiority over his fellow-workmen, just as the able business man is successful above such as have a lesser degree of business ability. There is neither good policy nor justice in establishing a uniform rate of wages per hour or per diem, by which all workmen—good, bad or indifferent—fare alike. Considered entirely with reference to the workmen, it takes away all motive or inducement for the skillful and conscientious workman to do his best, and places a premium on the methods of the drones, whose sole object from the time of commencing their day's work is the signal for quitting.

The value of the results, and not the hours, would, under normal conditions, be the basis upon which the rate of wages was established, as is the custom in some of the trades having organizations, iron and steel works, for example. But in the majority of cases the rate is on the time basis, and is fixed by the organizations and not by the employees. This being unquestionably an abnormal condition, requires the use of, let us say, unusual means to enforce and maintain it. Is it not reasonably certain that a removal of the restriction would result in an immediate return to payment for value instead of for time? It does not follow that this would involve a reduction of the value rating, or that the deserving workmen would realize less remuneration for their day's work. That would be decided by the condition of the labor market, as regards the relation between supply and demand. But, from any standpoint, it would certainly be justice to both workman and employer, as being the natural outcome of cause and effect.

The question of wages, however, is but of secondary importance as compared with others which constitute the real issue. As an abstract proposition, it would be deemed absurd to question the right of a workman to solicit or accept employment from whomsoever he saw fit, and

on such terms and wages as were mutually satisfactory to the parties directly interested. Neither could it be doubted that he has an unrestricted right to use his own judgment as to whether or not his individual interest and desire would be best served by his becoming a member of the organization representing his particular trade. Certainly this, if anything, is what constitutes the rights of every citizen of a free country, whether he be a workingman or not. He has the right to be a free agent in all matters of a lawful nature, and any attempt to coerce him into waiving such rights is, in itself, both unlawful and unjust. There can be no doubt that the intent and motive of organization was to secure to the workingmen the advantages of systematic methods for the protection of their interests by lawful means only. Neither is there any question as to the policy of the legislative and executive departments of the organizations being strictly in conformity with the original intention.

But unfortunately for the interests of labor, as well as of the community at large, the transgression of these limits has become so common as to make it the rule. First, by insisting, upon pain of ostracism, that every workman shall become a member of the organization of the trade to which he belongs, which, as a rule, is the only one in which he is able to earn a livelihood for himself and family. Practically, this amounts to compulsion, as the result of his failure to join the union means the loss of his livelihood; second, the deplorable tendency of the rank and file, in the event of disagreement with the employer, to resort to force in case the issue should result in a strike. No effort is spared to prevent non-union workmen from filling their places on the employer's terms, and where persuasion fails, force, amounting to violence and personal injury of the "scabs," is resorted to. That this is almost invariably in direct opposition to the counsel of the authorized leaders of the aggrieved union does not make it any the less deplorable in its results. If on a large scale, like the Homestead affair, there is almost sure to be more or less loss of human life, and an almost incalculable financial loss to both sides of the controversy. Even if public sentiment is in sympathy with the workingmen, the fact remains that they are violating the laws made for the government of the community—alike for their protection as well as of the capitalist—and that they are therefore placing themselves in a false position, and leaving the officers of the law no choice but to proceed against them, even if it be necessary to invoke the aid of the military. It is a hopeless task for them to undertake to set the entire commonwealth at defiance and cope with the large military force at its disposal, and besides there is always a disspiriting moral influence present where men are engaged in the commission of an unlawful act, even though they may feel that justice is on their side. Clearly this condition of affairs is an abnormal one, and will continue to exist just so long as the artificial influences continue, which have caused and maintained it so far. Relax them in the least and the tendency to return to the natural level will manifest itself.

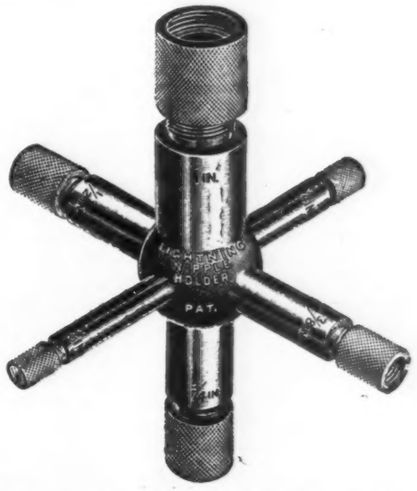
But the magnitude of the labor question seems to place its solution beyond the pale of mere theorizing. Systematic effort on the part of employer and workman, jointly, would surely accomplish it were each willing to try and view the matter from the standpoint of the other as well as his own; and there must be an honest desire, on the part of a large majority on both sides, to have their relations placed upon a more amicable footing. Let the workingman consider what would be his position in the controversy were the employers to exercise their full power to his hurt—to retaliate in kind in case of a strike where the support of the entire organization was given to those directly involved. Should all employers engaged in the line of business affected decide to summarily discharge all of their union employees and sacrifice their business interests for the time being, they could do so and still suffer no personal hardships. But to their employees it would mean simply starvation unless they could obtain financial help on a large scale from other trade organizations, in which case other establishments would be closed, and the end would only be reached when the lockout would include all organized labor. Where, then, could they find the means of subsistence? The men might be willing to suffer the most extreme hardships rather than give in, but they could not endure the sight of starving wives and children. No ordinary intelligent workingman can fail to see the possibility of such concerted action on the part of employers, nor that each recurring disturbance renders the danger more imminent. The experience of the past goes to clearly confirm this view, and each succeeding conflict can but emphasize it.

There are among the wage workers many men of more than ordinary intellectual caliber and moral force whose influence among their fellows would enable them to become leaders should they so desire. If such men could be induced to exert themselves in behalf of the real welfare of their respective organizations and the cause of labor in general, there can be but little doubt as to the result. If half the energy were shown by the moderators as is expended by the agitators, in season and out of season, the solution of the problem—possibly the greatest of the social problems of the age—would be accomplished.

The time is not so far behind us when labor troubles were unheard of in this country, and if such were possible a quarter of a century ago, surely the progress in this progressive age should be of improvement, and not the reverse. Let employer and employed alike go in for the study of the principles of political economy and each apply them fairly and dispassionately to his own side of the issue. It will pay.

A Convenient Tool for Pipe Fitters.

The Wiley & Russell Manufacturing Company, of Greenfield, Mass., are placing on the market a nipple holder for the use of pipe and steam fitters. The illustration represents a specimen of the device, which is intended to hold nipples at one end so that they can be threaded without injuring the thread at the other end of the nipple. The advantages afforded by this convenient device will readily be seen and appreciated



by those who have had their nipple holders lost or mislaid. Any one of the arms may be grasped in a vise to bring a required size into position. The nipple is made up in the coupling as far as it can readily be screwed with the fingers, and the coupling is then run down until the nipple stops against the plug. It is then ready to be cut out, and can afterward be taken out without trouble. The tool measures 9 inches across and weighs 4½ pounds.

The Estimating of Nitrogen in Coal Gas.

[Abstract of a paper, read by Mr. C. H. New, before the Society of Chemical Industry, Manchester Section, England.]

Mr. New commenced by remarking that, among the numerous methods suggested for the estimation of nitrogen in gas, there were none, to the best of his belief, which are not founded either upon the conversion of the nitrogen into ammonia, or the measurement of the volume of gas obtained after the removal of all other gases by absorption or other suitable means. Owing to the presence of appreciable quantities of cyanogen and basic compounds, the former method was not, he said, capable of being readily applied to the estimation of nitrogen; and therefore it was upon the latter—viz., that of ascertaining the volume or the residual gas—that the process he was about to describe was based. He then explained that the circumstances which created the need for a speedy and accurate method for the purpose named arose in connection with some experiments which were being conducted by his principal (Mr. G. E. Davis) in the Manchester Technical Laboratory, as to the quantity of air which it is advisable to introduce for the purpose of purifying coal gas. It was desirable to ascertain that the air so employed should not be used in unduly excessive proportions; and it was with this object that the method had been adopted, since by learning the quantity of nitrogen present both prior and subsequent to the introduction of the air, a very close approximation could be made of the bulk of air admitted.

The outline of the author's process consists in first removing the majority of the bases and certain hydrocarbons (such as benzene, xylene etc.,) by passing the gas through strong sulphuric acid, of 1.85

sp. gr., and converting the whole of the remaining hydrocarbons into carbon dioxide and water by passing the gas over red-hot copper oxide. The gases resulting from this treament consist of carbon dioxide and nitrogen; so that the former may be absorbed by cautic soda, and the volume of the remaining nitrogen arrived at. The apparatus employed is not elaborate in character; the idea being that the manipulations should be as simple as is compatible with accuracy. It may be divided into five parts: (1) An apparatus for generating carbon dioxide. (2) A burette graduated to hold 100 c.c. of gas, fitted at the top with a three-way tap, and connected at its lower extremity with an aspirator. (3) A combustion-furnace containing a combustion-tube about 80 centimeters long, projecting some 10 or 12 centimeters beyond the furnace, and packed with coarse copper oxide to within 7 centimeters of the ends of the tubes, which are fitted with india-rubber bungs. Through each bung passes a piece of small-bore glass tubing; one being connected with a bottle of about 30 c.c. capacity containing strong sulphuric acid. (4) A receptacle, capable of holding 200 c.c., and graduated with a containing mark at 150 and 200 c.c., in which to collect the carbon dioxide and nitrogen resulting from the combustion of the gas. (5) A Hempel's gas apparatus.

The author gave further particulars of the apparatus (which was illustrated,) and he stated that, although the process might possibly appear rather involved when detailed at length, it was by no means so in practice, since the whole operation, from the passing of the carbon dioxide to the final reading of the nitrogen, could be accomplished in 30 minutes. He then proceeded as follows: Assuming the combustion-tube and copper oxide contained therein have been raised to a full red heat, during which operation a current of air has been aspirated through the tube by means of a Bunsen pump, so as to carry away any aqueous vapor which may be given off, and to ensure that none of the copper remains unoxidized, the air-pump is stopped, and the carbon dioxide generating apparatus is connected through the three-way tap with the combustion apparatus. A brisk current of carbon dioxide is then passed through the sulphuric acid absorber and combustion-tube; thus sweeping out all traces of air. After this has gone on for about three minutes, the tube connecting the three-way tap with the absorption-bottle is closed by a pinch-cock; and the gas receiver, having been completely filled with mercury, is joined to the other end of the combustion-tube—care being taken to avoid entrance of air. The pinch-cock intervening between the carbon dioxide generator and the three-way tap is also closed. The india-rubber tube connecting the absorption-bottle with the three-way cock is then temporarily removed; and after displacing all air in the burette with mercury, coal gas is admitted by connecting with the gas supply and lowering the aspirator bottle—the gas being adjusted to the 100 c.c. mark by leveling the height of the mercury. The absorption-bottle is now again attached to the three-way tap, and the pinch-cocks both here and at the top of the receiver opened. The gas is then slowly chased over from the burette through the absorption-bottle and the combustion-tube; the rate at which the gas is passing being ascertained by observing the bubbles in the absorber. The displacement of the 100 c.c. of coal gas should occupy about 15 minutes. When this is done, the connection with the burette is closed, and the tap is once more connected with the carbon dioxide generator, from which a current of carbon dioxide gas is slowly passed through the whole apparatus—displacing the coal gas in the absorber, and carrying over into the receiver all the nitrogen in the combustion-tube. The mercury in the receiver is brought during the experiment nearly to a level, maintaining the gas, however, under a slight pressure, and adjusting the same by means of the small tap at the bottom, so that, when the gas reaches the 150 c.c. mark, and the pinch-cock at the top and the tap at the bottom are simultaneously closed, the levels of the two columns of mercury are coincident with each other. The receiver is then disconnected; and the combustion-tube having been opened to the air, the pump is again started to reoxidize the copper oxide. The wide-mouthed limb of the receiver is then filled with mercury, and 100 c.c. of the gas passed into the Hempel burette; the carbon dioxide being absorbed with caustic soda in the usual way. It has also been found necessary to remove traces of oxygen from the gas before taking the final reading as nitrogen. The average amount of oxygen in coal gas, as taken from 19 experiments upon the gas of towns in all parts of the United Kingdom, is, according to Frankland, about 0.3 per cent.; and a varying amount of this oxygen passes over the nitrogen and carbon dioxide, though it would be supposed that a considerable portion be retained in order to reoxidize the reduced copper. Having, therefore, removed all oxygen, the volume of remaining gas is noted, calculated on to 150 c.c., and after correction for temperature and pressure gives the percentage per volume direct. In summarizing the foregoing, there are five precautions which it is advisable to observe: (1) To work the apparatus under a slight pressure; (2) to make sure that all air is displaced before commencing the experiment; (3) to ascertain that the carbon dioxide used in wholly absorbed by caustic soda; (4) to thoroughly reoxidize the copper oxide, so as to avoid the presence of any metallic copper in the tube; (5) and, lastly, to pass the coal gas at a rate that will ensure complete oxidation.

The figures given below indicate the amount of nitrogen found in the Salford gas as supplied to the Manchester Techinal Laboratory; being a series of tests made at different times during a period of several weeks:

No. of Experiment.	Nitrogen per Cent. per Volume.		No. of Experiment.	Nitrogen per Cent. per Volume.	
1	14.1	Day.	9	10.3	Night.
2	13.5		10	6.3	
3	13.8		11	7.0	
4	8.7		12	7.3	
5	7.4		13	7.6	
6	6.4		14	7.8	
7	10.9		15	4.6	
8	11.7				

The author then went on to remark that, in the early days of the gas industry, it was considered highly detrimental to the quality of gas to admit the slightest quantity of air; and he quoted, in support of his statement, an extract from a report made in 1878 by the then Manager of the Salford Gas Works. He also gave a table showing that gas of 25-candle power is reduced to 22-25 candles when 2 per cent. of air is added, and to 16.75 candles when 5 per cent. is introduced. It was, therefore, he said, safe to assume that the quantity of nitrogen found in Manchester gas, as given in Roscoe's translation of Bunsen's "Gasometry," might be taken as representing the amount of nitrogen existing in the gas itself, and not due to the introduction of air—the amount there stated to be present being 2.46 per cent. He then gave the two following analyses of the gas of Manchester attributed to Bunsen; recommending the second as being the more suitable for the purposes of comparison;

	No. 1.	No. 2.
Hydrogen	45.58	45.58
Marsh gas	34.90	34.90
Illuminants (Elayl)	6.46	4.08
Illuminants (Dietryl)		2.38
Carbonic oxide	6.64	6.64
Sulphureted hydrogen	——	0.29
Nitrogen	3.67	2.46
Carbonic acid	——	3.67
Oxygen	2.46	nil.

Mr. New next pointed out that the amount of nitrogen occurring in coal gas was in many cases much greater in 1883 and 1884, when the use of air was on the increase, than it had previously been. This he showed by the following figures, giving the percentage of nitrogen, as ascertained by Frankland, in the gas supplied about that time to the towns named: London (The Gaslight and Coke Company), 5.95; Liverpool, 6.10; Birmingham, 10.10; Bristol, 5.11; Newcastle-under-Lyme, 6.22; Ipswich, 10.84; Preston, 4.79. He also showed, by the results of tests made at different times on several days, that the amount of nitrogen is much larger in the daytime than at night—an occurrence which, he remarked, was of such significance as to need no explanation. In one case, the percentage of nitrogen was 11.7 at 1 P.M., 10.9 at 1.30, and 8.7 at 4.30; in another, it was 13.8 at 4.20; in a third, 14.1 at 1; in a fourth, 10.3 at 7.30. Other tests showed 4.6 per cent. at 8; 7.6 per cent. at 8.20 (and 7.8 per cent at 9.40); 7 per cent. at 8.50 (and 7.3 per cent. at 9.20).

In the discussion upon the paper, the Chairman (Mr. Levinstein) asked whether he fully understood the author to say that there was more air in the gas in the daytime than in the evening. If so, how did the air get into the pipes? If it were pumped in, how did he know there was more in the house than at the station? He understood it was due to the distance. Mr. Stenhouse thought the results obtained by Mr. New were most extraordinary, inasmuch as the 14 per cent. of nitrogen at 1 P.M. (given among his tests) meant a great quantity of air, which must have been purposely forced into the gas; and not only would there have to be a large quantity of air pumped in, but there would have to be a corresponding proportion of oxygen. Probably the oxygen would he reduced 1 per cent., assuming the coal gas to contain 1,000 grains per 100 cubic feet of sulphureted hydrogen. There would be sufficient oxygen to oxidize the sulphureted hydrogen and deposit all the sulphur. Therefore a quantity of air would go forward. Was it quite certain that all the compounds that should be absorbed by the sulphuric acid were taken up by simple bubbling? Surely the gas had to be agitated with the different reagents before the compounds were absorbed. Dr. Grossman asked if the author had made an analysis

of the air; and, if so, what figures he had obtained for nitrogen. The apparatus seemed to him to require to be handled very carefully, or the results would not be reliable to the extent of 1 or 2 per cent. Mr. Stenhouse stated that, according to a recently published analysis of London gas, the average was 0.15 per cent. by volume of oxygen, and less than 1 per cent. of nitrogen; and this was greatly different from the results shown by the author. In reply to the last speaker, Mr. New remarked that Frankland found on more than one occasion 10 per cent. of nitrogen; and he had himself found oxygen in coal gas to an extent which would correspond to the excess left after that which was required for reducing the sulphureted hydrogen had been used up. In regard to the complete removal of the compounds absorbed by sulphuric acid, this was only used in a bubbling-bottle, in order to ascertain the rate at which the gas was passing. As a result, some of the hydro-carbons were absorbed; but it was immaterial whether they were or not, since they would all be decomposed during their passage over the red-hot copper oxide.

Ventilation and Measurement of Cubic Space.

Sir Douglas Galton notes that the great object of efficient ventilation is to enable change of air to take place without its being unpleasant from the draughts which it occasions. This change of air is governed by certain natural laws. Air consists of molecules, which are very loosely attached to each other, and small increases of temperature or slight diminution of pressure allow these molecules or particles to separate, and thus a cubic foot of warmed air weighs less than a cubic foot of cold air. For instance, at a temperature of 32° F., a cubic foot of cold dry air, at the level of the sea, would weigh about 567 grains. At a temperature of 100° F., a cubic foot of air would only weigh 497 grains, and at a temperature of zero, that is 32° below freezing point, it would weigh 606 grains.

It follows from this that air, when it is warmed, expands and ascends; and air, when it is cooled, contracts and falls. It also follows that as the warm air ascends the colder air rushes in to fill its place. Everywhere this heating and cooling of the air is going on; the sun's rays warm the objects on which they impinge, these objects in their turn warm the air: the vicinity of a shaded surface cools the air, and thus both in turn cause movements in the currents of air. In the room, as air is warmed by our bodies, it ascends; it comes against the glass of the windows or skylight, cools and falls down. You say that you feel a draught from the window; that is not necessarily air coming in from the window; it may simply be the cooled air falling on you.

It is on this law of the dilatation of air that all the movement of the atmosphere depends, from the winds and hurricanes to the ventilation of our houses, except where we propel air by fans or other mechanical appliances. The law which regulates this movement of the air in a confined space, when the temperature is higher than that of the outside air, depends upon the following considerations: 1. Upon the difference of temperature of the air inside the confined space, as compared with that outside. 2. Upon the area of the aperture through which the air passes. 3. Upon the height of the column of ascending air.

If A B represents the height of a column of air of the outside temperature t, and A C the height of a column of the same quantity of air expanded by the warmer temperature t', then the velocity at which the warmer air ascends will be that which would be acquired by a body falling from C to B. The theoretical formula due to this is:

$$V = \sqrt{B C \times 2 g}.$$

And where V = velocity in feet per second.
H = height of shaft.
t' = temperature in shaft.
t = temperature out of doors.
a = coefficient of dilatation of air, which for 1° F. = .00203.

The theoretical equation became $V = 8.204 \sqrt{Ha\,(t'-t)}$.

But the actual movement of air in a flue is very different. It is diminished by the resistance afforded by the chimney or flue in which the column of ascending air is contained. This resistance increases directly with the length, and inversely with the diameter or area of the flue; and it also increases with the square of the velocity of the air currents.

The resistance is, moreover, much influenced by the material forming the sides of the flue. With a sooty flue the velocity, with equal temperatures, has been found to be one-half that of a clean flue. The velocity is, moreover, diminished by any impediment to the ingress of the fresh air required to supply the place of that which flows out; and therefore an efficient system of ventilation requires that the extraction of air should be accompanied by arrangements for the supply of fresh air. For these reasons it is preferable, in estimating the amount of air removed for purposes of ventilation from buildings already constructed, to measure the actual volume of the air in the flues or air passages—that is to say, to cause it to pass along a channel the size and area of which are known, and then to measure the velocity with which the air passes through this channel. The multiple of the area into the velocity in a given time gives the volume which passes through in that time.

There are various ways of measuring the velocity. It may be done by puffs of vapor of turpentine; by little balloons filled with hydrogen, and weighted to be of the exact specific gravity of air. A very convenient instrument is the anemometer. The vanes are turned by the air, and the number of the revolutions, apportioned to the movement of the air, has to be ascertained in the first place by direct experiment, that is, by forcing a known bulk of air through a channel of a given size. That is to say, you provide a box or a cylinder of a certain size with a piston, and in connection with this box you place a tube of a known area and fitted to the size of the anemometer. You place the anemometer in the tube and you note its reading. You then cause the piston to descend in a given time and thus force the air contained in the box through the tube. You then note the reading of the anemometer, and thus ascertain the number of revolutions which coincide with the volume of air which has passed through the tube out of the box.

This method requires great care and attention, and the absence of all cross currents in the place where the experiment is made. Another method for very roughly ascertaining the value of the revolutions of the anemometer is to draw the anemometer through the air at a given rate in a given time and note the revolutions, but this is liable to many errors.

In heated flues and chimneys of manufactories, Fletcher's anemometer is a very convenient form for measuring the speed of the air and gases. The instrument consists of two parts. The first part consists of two metal tubes of about three-tenths of an inch internal diameter, open throughout, and of any length; secondly, of a manometer, or pressure gauge. Of these tubes the end of one is straight, while that of the other is bent to a right angle. When in use these tubes are placed parallel to each other, so that their ends are exposed to the current of air to be measured. They lie at right angles to the current, which thus crosses the open end of the one, and blows into the bent end of the other. By this means a partial vacuum is established in the straight tube, whilst the pressure of the current forces the air into the bent tube. A differential manometer attached to the outer ends of the tubes shows the excess of pressure in the bent tube over that in the straight one. The manometer used is a simple U tube set vertically, fitted with microscopes and vernier scales, and containing ether.

The difference of level of the surfaces of the ether in the two limbs can be measured to $\frac{1}{1000}$ of an inch. The difference of level between the columns of ether becomes a measure of the speed of the current passing the ends of the anemometer tubes; the law which governs the speed is expressed generally by the formula $v = \sqrt{p} \times 28.55$. The corrections to be made for small variations of barometric pressure and temperature are unimportant.

This is a very convenient form of anemometer, because the pressure tubes may be of any length or diameter, and may be connected with the manometer by India rubber tubing of any length. Therefore the readings may be observed in any convenient place at a distance from the flues. The pressure tube should project into the air current to the extent of one-sixth part of its diameter, to measure the average velocity. It is desirable, after observing the height of the ether in the tube then to reverse the connection with the manometer, and to take a second reading; if the smaller reading be deducted from the greater, twice the height of the column supported by the difference of pressure is obtained and the error of observation is halved. But in this, as in the anemometer with vanes, there is a difficulty in accurately observing low velocities, *i. e.*, under one foot per second.

It is worth noting that a sheet of light tracing paper moved through the air at two feet per second takes up an angle of 45°, and affords a ready means of measuring that velocity, and for smaller velocities the angle assumed by the flame of a candle affords a fairly accurate index according to the following table:

Velocity of flow of air. Feet per second.	Angle of inclination of flame of candle with horizon.
1.6	30°
1.0	40°
0.75	50°
0.50	60°
0.40	65°

Artificial methods in use for moving air may be classed as follows: 1. Movement by the application of heat to extract air, thus causing a vacuum which is filled up by fresh air rushing in to fill its place. Of this method the open fireplace is a familiar instance. 2. The use of pumps to draw out or to force in air. 3. The use of fans either to extract the air from or to force it into the space to be ventilated.

You will see from the formula for calculating the velocity of air in a shaft or flue that the velocity will vary either with the height of the shaft or with the temperature of the shaft. Hence a tall shaft with a small increase of temperature of air may produce as high a velocity as a short shaft in which the temperature is high. In this latter case it would be necessary to consume a large amount of fuel to increase the temperature of the air which passes up the shaft. Therefore the economy with which the law of dilatation of air can be applied in practice depends on the height of the shaft available.

If you require the extraction of air to go on continuously you will find that a lofty chimney shaft will be the cheapest and most effectual way of securing your object. It is simple and permanent. It requires comparatively little repair, and no skilled labor to look after it. Moreover, whilst a chimney flue acts by means of the dilatation of air, it also acts in another and occasionally very efficient manner. Whenever wind blows over the top of a shaft it draws with it the air in the shaft and causes an extraction; and as movement is almost always taking place in the atmosphere out of doors you may almost always rely upon a certain degree of extraction of air from a house or a room by means of shafts carried up to above the roof, which is independent of the temperature of the air in the shaft. But if you only want ventilation to be put in operation from time to time, as in a meeting hall, it may often be found that when you take into consideration the first cost, the extraction of air by a properly-constructed fan worked by a gas or other heat engine would in many cases be more economical than the flue extraction; in all cases the warming of the air which takes the place of that removed must be taken into account.

The most efficient, and at the same time most simple, method for removing the air of a room without having recourse to fans or other mechanical appliances is to carry up shafts from the room to above the roof, so as to utilize the movements of the atmosphere, to which I have already alluded, to assist the movement which would naturally take place, partly from the warmer air of the room rising up through the shaft, and partly from the movement of the atmosphere outside, which, as I have already mentioned, will draw air up the tube. Thus, if the atmosphere should be without perceptible movement in cold weather, when the temperature indoors is maintained for comfort above that out of doors, the difference of temperature will cause an upward movement in the shaft. In hot weather, if the shaft is colder than the outer air, a down current may probably ensue; but if in hot weather there should be little or no movement in the shaft, this occurs at a time when the windows can be kept open and the air be renewed by this means.

The velocity due to the action of the wind which prevails in a shaft is modified by friction. This friction varies inversely with the area of the shaft, and in the case of small tubes it forms a very perceptible element of retardation. Experiments made with tubes 3 inches in diameter tend to show that the velocity obtained in the tube was about two-fifths of that of the wind; larger diameters, on the other hand, produce better results. These results were obtained in a place supplied as far as possible with fresh air to replace that removed, in a manner as far as possible independent of the movement of the atmosphere, and with the top of the tube freely exposed on all sides. These shafts will very rarely be found to be without action, for the atmosphere is always more or less in movement, and whenever there are currents passing over the top of the shaft an upward current is produced in the shaft.

Inventors frequently maintain that this action of the flue or shaft is influenced by special forms of cowls. No doubt you must have a top or cover to the shaft to prevent rain coming down; but numerous experiments which have been made by a committee of the Sanitary Institute tend to show that, with equally sized apertures at the top, an open tube would act best, and that the principal condition in the shape of the top which influences the velocity, under similar conditions of force of wind, is the area of the aperture as compared with the area of the upcast flue. That is to say, an increase in the area of the aperture of the top, properly regulated as to shape, may, under certain circumstances, produce an increased velocity in the upcast flue; and where a cowl appears to show an increased velocity in an upcast flue, it results from the enlarged area afforded by the cowl as compared with the area of the shaft.

Where large numbers of persons are to be provided for, especially, for instance, in schools, some mechanical means of supplying air is absolutely necessary; but in ordinary houses the simplest plan of providing warmed air is to utilize some of the waste heat, which, in the case of an ordinary open fireplace, passes away unused up the chimney. The ventilating fireplace, which has been generally adopted in barracks, was designed with the object of obviating the above-named objections to the common fireplace, and to utilize the spare heat, as well as to provide such adequate means of ventilating the soldiers' rooms in cold weather when the windows are shut, as would not be liable to be deranged. Fresh air is admitted to a chamber formed at the back of the grate, where it is moderately warmed by a large heating surface, and then carried by a flue, adjacent to the chimney flue, to the upper part of the room, where it flows into the currents which already exist in the room.

Barrack rooms have fireplaces and windows, but these are not sufficient as ventilating appliances in rooms where there are many occupants. The ventilation is therefore supplemented by Sheringham's valves near the ceiling, and by shafts carried from the ceiling to above the roof. These shafts have generally been made of wood or brick; for if made of zinc, exposed to the outer air, that part of the action which is due to the excess of the warmth of the air of the room over that of the outer air would be retarded in cold weather.

The methods of ventilation which are adequate for barrack rooms would not suffice for places where large numbers are congregated, as, for instance, in large school rooms. In these it would be preferable to adopt either a method of forcing in fresh air by means of a fan, or of extracting the air by means of a powerful shaft, and replacing the air thus extracted by fresh air. In a properly devised building the latter would be the most economical arrangement. With proper arrangements for the supply of fresh air, the purity of the air would be the same in either case. But in our large Board schools you may take it as an axiom that you cannot secure adequate ventilation without the application of some mechanical system; and that, in order to obtain the greatest economy in the application of a mechanical system, it is essential that it be made a part of the original design.

The fresh air should be obtained from places where there are no adjacent sources of impurity; especially not from the vicinity of ash pits, manure heaps, gully gratings or other sources of foul air. The inlets from the outer air should be at least 2 feet from the ground, and the surface near should be paved and sloped away from the inlet, so as to carry off wet rapidly. It has been estimated that the impurities of town air are very much diminished at 200 yards height, and are not found above 600 yards in height. A London fog will rarely be perceptible at a height of above 100 yards; consequently, to bring pure air into a large town, the simplest way would be to draw it down from a height by means of a high shaft or tower. The Houses of Parliament could be supplied with very much purer air than is now provided for them by bringing the air from the top of the Victoria Tower.

Gas Furnace Valves.

By Mr. J. W. Wailes.

The importance of thoroughly efficient valves for furnaces using gaseous fuel is sufficiently well known by the large body of users of this class of furnace to need no more from me than a passing remark. If we consider the large amount of coal which is applied to manufacturing purposes at the present day in the form of gas, it requires little insistence to enforce the important fact that even a small escape that finds its way to the chimney without passing through the furnace or doing any work represents in the yearly aggregate a very formidable sum to be put down under the head of absolute loss. The escape is, however, often anything but small, and is always constant when valves are leaky. That there is a weakness in furnaces in the detail of valves is well known and generally recognized, and it is attested by the fact that over 80 patents have been obtained for improvements in valves and connections therewith.

Regarding the functions of these valves, the first consideration which strikes us is that the currents to be controlled and directed are of very small pressure, not equal to more than about half to three-quarters of an inch of water. If it were only a question of dealing with the incoming gas and air at their moderate temperatures, the problem might not offer any great difficulty, but the question is at once complicated when the outflowing currents from the furnace have to be considered, as these currents, from a variety of causes, are often at a high heat—sufficiently high to destroy the fit of the valves. It may be urged that these conditions should not be allowed to arise; but they do arise, and it is often the task of the engineer to deal with things as he finds them, when un-

able to obtain what ought to be. Another condition which always exists is furnished by the fact that the pressure of gas acts on one side of the valve, and the draught of the chimney on the other, so that inaccuracy in the fit of the valve allows very serious loss. And here a further complication comes in; the escaping gas ignites at the under side of the valve, and the heat resulting continually makes the trouble worse. I have often noted with surprise, on examining a valve removed for repair or refitting, how a comparatively small defect had impaired the working of a furnace; and as a leakage has the effect of delaying the operation of a furnace, the defect acts and reacts—the greater the defect the greater the delay, and the greater the delay the greater becomes the defect.

A large number of furnaces at the present time are working with the original four-way type of flap valve. This valve is too well known to require description here. In the presence of engineers it is hardly necessary to state that whatever advantages this form of valve may have, when it is once out of shape it is a matter of impossibility to make the flap fit again. If you are successful in obtaining a fit on one side, it is at the cost of a misfit on the other; so that the plan which usually obtains is to arrive at a kind of a compromise by making the best fit possible under the circumstances at each position of the flap, but not good in either case. Another form of valve that has been largely adopted lately is that of the double seat type, with a circular valve on a spindle alternately closing on one or the other of the seats. This form of valve being of massive construction and uniform shape, is not so greatly affected by heat, and gives, I think, better results than the old four-way type just referred to; but it is open to many of the objections common to all classes of cast iron gas valves. If we consider the small pressure furnace valves have to resist, the idea of employing these heavy masses of cast iron becomes something very like a mechanical absurdity.

In the valve to which I have now to direct your attention it has been attempted to obtain an obsulute gas-tight closure—a perfect water seal—and at the same time to entiely avoid any of the objections to the use of water arising from evaporation filling the flues with vapor, or cooling the current so as to impair the draught of the machinery. In the belief that these conditions have been obtained must be my excuse for occupying your time with a matter so simple; but though simple, it has, I think, a very importune bearing on a most gigantic branch of metallurgical enterprise. I also trust it is an earnest and well-meant attempt to perfect in one of its important details the great invention left by the genius of Siemens. The valve (if it may be so-called) is of the most simple form and construction; it is merely a trap constructed of malleable plate, like an ordinary gas-tube, the passage being closed and opened by being filled and emptied with water. A vessel holding water is raised and lowered on this trap; the vessels being balanced, and friction absent, little effort is needed to perform this operation. When the heated currents are passing, the passage is empty and dry, so that, as I have stated, the important condition of avoiding evaporation and cooling is obtained. There is absolutely nothing to get out of order; if the passages are distorted by heat at any time, no harm is done; the water simply fills the space, of whatever shape it may be. Small leaks, if they should arise, are of little consequence.

The opening at the bottom of the gas-passage through which the water flows is larger than in the case of the chimney-passage, as heated currents do not pass this, and extra opening is no objection; and by keeping sufficient room at this point the tar falls freely into the water-vessel, and is easily removed if it should collect. The operation of reversing must be done by steady means, such as a screw, worm-wheel, or means not liable to jerks, which might spill the water. The water-vessels, by means of a ball-valve, may be automatically supplied, or it may be done by hand with a small hose-pipe. The arrangement has the further advantage of being inexpensive, durable, and requiring very little in the way of maintenance. The water-valve need only be used in the case of the gas, the air-valve may be a simple tube with a flap, as a perfect fit in an air-valve is of small consequence.

Field Riveting.

By Z. Foster, C. E., in *The Technograph*.

Most of the riveting required in the field on bridges or on buildings, is done by hand work. The ordinary rivet gang consists of two strikers, a holder on, and one man to heat rivets. Their outfit comprises a forge, tongs, hammer, snaps, dolley, drift pins and rivet buster. When supplying one gang the heater usually has four or five rivets in the fire at one time.

The amount of riveting a gang can do depends on the character of the work, the accessibility of the rivets, the number of rivets to be driven in each connection, and upon the men who drive them. There is practically no difference between steel and iron riveting when men become accustomed to using the steel. In pin-connected bridges a gang of four men can drive on the average 125 rivets per day of 10 hours, and when the rivets are small or easy to get at 300 can be driven in one day. "On a lattice truss bridge 500 rivets can be driven in a day of 10 hours, the work being easily reached. On lattice spans of from 135 to 150 feet a gang ought to average 400 rivets a day without trouble."

As the cost of field riveting is not often kept separate from the cost of erection of bridges, accurate data is hard to get. Bridge erection is contracted for by the lineal foot of span or by the pound of metal in the structure, and each item of cost is not given separately. In making estimates some contractors allow $1 per ton of metal for the expense of rivets and field riveting. A gang of four men costs from $13 to $15 per day of 10 hours, varying with the location of the work. The actual cost of field riveting will vary with (1) the designer, (2) the class of structures —*i. e.*, pin-connected, lattice, plate girder, through or deck bridges, etc., (3) the location of the structure, (4) the time of year the structure is erected, and (5) on the amount of riveting a gang can do in an average day's work.

Mr. Lincoln Bush, class of '88, University of Illinois, gives the following as the result of his observation while inspector of erection of pin-connected spans of from 147 to 208 feet. "The cost is for actual time worked at driving rivets by experienced men, and does not include cost of falseworks and preparation for driving. For ⅞-inch rivets the average cost was 4¼ cents per rivet, while 1-inch rivets cost from 10 to 15 per cent. more owing to the extra time and care in heating the larger rivets. The rivets in the drum of a draw span cost about 10 cents each. These prices include rivets that are lost from not being caught. Where loose rivets were found, they were cut out and replaced."

The estimated cost of field riveting, as given by engineers of bridge work, is: Berlin Iron Bridge Company, "about 10 cents per rivet in place;" Phœnix Bridge Company, "varies from 5 to 10 cents per rivet;" Missouri Valley Bridge Works, "uses in making rivets 10 cents per rivet, though they sometimes cost more;" King Iron Bridge Company, "varies from 5 to 20 cents." On lattice truss bridges, a gang of riveters cost $15 per day for 10 hours, and can drive on an average 400 rivets, which makes the cost 3¾ cents each.

"According to Mr. S. V. Ryland, the contractor for the erection of the Hawkesbury bridge, the cost of the field riveting in that bridge was not far from 10 cents each, and many of the rivets cost over 20 cents each, the riveting being done by English and native workmen. The cost of field riveting in Great Britain, as given by Sir Benjamin Baker in a letter several years ago, was: 'The floor of the Tay bridge, over 2 miles long and 26 feet wide, was all riveted up with portable hydraulic riveters in the field, and cost 60 cents per 100 rivets. In plain girder work, field rivets driven by power usually cost on an average about 72 cents per 100 rivets. Joint covers, lattice and connections cost from $1.92 to $3.36 per 100 rivets, or 2 cents to 3½ cents each.' In one of our large railways, where lattice and plate girders predominate, the field riveting costs about 5 cents per rivet, which includes many redriven in old structures. The metal work of the Clyde viaduct, on the C. M. & N. Railway, near Chicago, is made up of two pin-connected spans 148 feet and 162 feet, and three plate-girder spans 60 feet—all through bridges. The pin-connected spans had stiff bottom chords, and all had solid box floors. On this work the field riveting cost the contractor on the average a little over 5 cents each, not counting profit nor wear on tools, etc. A fair estimate of the cost of field riveting is 6 cents per rivet, though many field rivets in badly designed connections doubtless cost as much as $3 each, and some possibly $5, but these are occasional cases."

In iron and steel building construction the number of rivets driven per day is about the same as in bridge work, and depends upon accessibility, fit of joint, etc. Purdy & Phillips, prominent civil engineers, Chicago, give the cost at from 4 to 4½ cents per rivet in building construction, and "in making estimates the price should not be less."

The contract price paid in 1891, on the Wainwright, a 10-story building, St. Louis, was 8 cents per rivet. On the German Opera House, Chicago, the cost is 5½ cents per rivet. On the Cook County Abstract Building, Chicago, 17 stories, the cost is 5¾ cents per rivet. On the American Express Company's barn the field rivets were driven for 4 cents each. In this barn the rivets were easy to get at, yet the men scarcely made ordinary wages. The weight of iron and steel in this barn is estimated at 1,450 tons, in which will be used 12,000 ⅞-inch rivets, costing about 2½ cents per pound; and with riveting at 4 cents the cost of field riveting per ton of metal is about 44 cents. This is probably lower than the average cost.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

MR. R. F. MULLEN, who has operated the Fishkill and Matteawan (N. Y.) gasworks, under a lease for two or three years, gave up the trust on the 18th inst. The works were to have been sold under foreclosure proceedings on Monday last, but we have not been advised as to the ultimate result.

THE Lion Gas Stove Company, of 141 and 143 Ontario street, Chicago, has been awarded the contract to furnish the "Plaza Apartment House," Chicago, with 120 gas ranges, with "canopy." This contract was only secured after a competition with several prominent gas stove manufacturers.

AT a meeting of the stockholders of the Bridgeton (N. J.) Gaslight Company, held on the 14th inst., the following named gentlemen were elected Directors for the ensuing year: Daniel Elmer, Chester J. Buck, Henry W. Elmer, M.D., William C. Mulford and Daniel Bacon. The last named takes the place of the late Jonathan Elmer. The Board subsequently organized by electing the following officers: President, Daniel Elmer; Secretary and Auditor, William C. Mulford; Treasurer and Superintendent, B. F. Harding.

WESTERN "OBSERVER," writing to the JOURNAL under date of the 20th inst., incloses the following: "At a called meeting of the Directors of the Ironton (Ohio) Gas Company, held at the Company's office last evening, Mr. W. W. Prichard tendered his resignation as Secretary and General Manager of the Company, to take effect August 1st, and the same was accepted. Mr. Prichard resigned so that he might accept an offer made by President Padan, of the Portsmouth (Ohio) Company, to take charge of the last-named works. Of course, the change means promotion to Mr. Prichard, whose management of the Ironton plant has been of the careful and competent sort." We are pleased to note that Mr. Prichard's course is upward, and we wish him that measure of success which always follows upright and straightforward dealing.

THE consumers on the lines of the Bergen County Gas Light Company, of Englewood, N. J., will hereafter receive their supply on the basis of a payment of $2 per 1,000 cubic feet. The plant betterments at this point are progressing.

ARRANGEMENTS have just been concluded for the building of a Pintsch gas plant at Toledo, Ohio, for the purpose of supplying gas to the Lake Shore Railroad Company's car equipment, on the routes between Toledo and Buffalo and Toledo and Chicago. The cars of the Wabash Company, and also those of the Cincinnati, Hamilton & Dayton Company will be supplied from the same plant. In all, it is estimated that 400 coaches will be lighted.

IT is also probable that a Pintsch system plant will be put in at Ashtabula, Ohio, with the Ashtabula Gas Light Company as the operators thereof.

CAPTAIN A. Q. ROSS, of the United States Steam Coking Company, having made an important business connection, will, we are sorry to say, soon leave the United States, to take permanent residence in Mexico, where the capitalists with whom he has joined hands have invested largely. Good luck to him, wherever he goes.

MANAGER THOS. D. MILLER, of the Dallas (Texas) Gas and Fuel Company, is meeting with much success in the placing of gas cooking stoves. Among other means employed by him to popularize these useful domestic aids was a well-arranged exhibition of many types of cookers, small heaters, etc. The Company also offers to exchange gas stoves for those of the gasoline type.

THE Crookston (Minn.) Gas Light and Heating Company was incorporated about a fortnight ago, with a capital of $100,000. This place is the capital of Polk county, Minn., and is on the Red Lake river, some 25 miles or so from St. Paul. It is also located on the St. Vincent extension of the St. Paul and Pacific Railroad. It has about 7,000 inhabitants, and now supports a fairly good electric light station, the motor power of which is obtained from the Red Lake river. If we mistake not, the electric plant is controlled by W. J. Murphy, who is also one of the leading spirits in the Gas Company at Grand Forks, North Dakota.

THE Directors of the Municipal Gas Company, of Albany, N. Y., have been authorized by the shareholders to tack on another half million to the capital stock, the increase to be issued in payment for the stock of the Albany Electric Illuminating Company. Incidentally, the shareholders elected the following Directors: Anthony N. Brady, Robert C. Pruyn, J. Howard King, William McEwan, John E. McElroy, E. L. Benedict and Roswell P. Flower. The Directors subsequently selected the following officers: President, Anthony N. Brady; Vice President, Robert C. Pruyn; Secretary and Treasurer, John E. McElroy; Assistant Secretary, Henry Bronk.

"OBSERVER," writing from Boston under date of July 23d, incloses the following: "Some additional developments will shortly occur in connection with the Bay State Gas Company, according to the *Beacon*. Very little has been said lately about the movement to bring about a reduction in the price of gas in Boston. That movement, however, has not been abandoned. On the contrary, very earnest and quiet work has been going on, and the advocates of reduction will shortly show their hands. Three new petitions have this week been filed with the Gas Commissioners. They recite that the price of gas is excessive and should be reduced to $1 per 1,000 cubic feet. These petitions are from residents of Dorchester, South Boston and Roxbury, and are signed by leading citizens of these districts. Up to date the Roxbury petition has 108 signers, the South Boston, 80, and the Dorchester, 58. These three petitions, together with the monster one recently presented by the residents of the city proper, cover the business controlled by the Bay State Gas Company. The Commissioners, therefore, have no lack of inducement to investigate the matter of a reduction in price thoroughly. The signers of the petition feel that if the case can only be impartially considered, every argument will be in favor of granting the appeal. It is sufficient, in fact, to recall to mind that over their own signatures the Commissioners have practically shown that gas could, under legitimate circumstances, be manufactured in Boston so as to be sold at a handsome profit at $1 per 1,000 feet. It is obvious what line of argument will be introduced by the petitioners to influence the Commissioners to reduce the price of gas. The capital stock of the Boston Gas Light Company is $2,500,000, that of the Dorchester Company, $400,000, the Roxbury Company, $600,000, the South Boston Company, $410,000; the total capitalization of the four Companies owned by the Bay State Gas Company being $3,940,000. There is a big difference between $3,940,000 and the $17,000,000 capitalization of the Bay State Gas Company. The signers of the petition have secured, as counsel to represent their interests before the Commissioners, Messrs. Boardman Hall and Geo. W. Anderson. The latter is a partner of Mr. George Fred. Williams, and altogether some very vigorous work may be expected of these gentlemen. Their services will be supplemented by the efforts of Messrs. R. M. Morse and Moody Merrill, who have been engaged as counsel by the petitioners from Boston proper, and all who know these gentlemen can anticipate what kind of a contest they will be likely to subject the gas people to. The *personnel* of the Commission of the State has undergone quite a revolution this month. One of the Commissioners has resigned, and the Clerk of the Board has also retired from office. If rumor is correct, the facts in connection with this change in the character of the Board are exceptionally interesting. They are supposed to amount to nothing more nor less than a deal between interested gas parties and well-known local politicians, whereby the resignations of the two gentlemee above referred to were brought about. It is not to be inferred that either the out-going Commissioner and Clerk of the Board or their successors had any inkling at all of such an arrangement, nor that the appointing power of the Commonwealth was in the least measure acquainted with any such design. Possibly the public will later on be permitted to learn more in detail what the exact nature of the deal was. In this connection it is proper to state that a Director of the Bay State Company made the remark recently that they had nothing to fear from the Commission, as any danger of trouble from that quarter would be thoroughly provided for. If anyone wishes to obtain a lucrative position with the Bay State gas interest, the surest way to do so would seem to be to have had some connection with the Gas Commission. The retiring Clerk of the latter body has entered the service of the Gas Company, as Assistant Treasurer, at a handsome advance in salary, and before beginning his active labors he is granted a vacation of several weeks, which he will pass in Europe. There, it is surmised, he will study the gas situation and gather all the data possible to show why a reduction in the price of gas should not be granted in Boston. In these labors very likely he will have the assistance of Mr. Coffin, late Gas Commissioner, and now counsel for the Gas Company, who is also in Europe."

MR. FORREST E. BARKER, whose reappointment on the Massachusetts State Board of Gas and Electric Commissioners was recently noted in

the JOURNAL, sailed for Europe, per steamship Alaska, on the 23d of July. He will return in the first week of September.

THE P. H. & F. M. Roots Company, of Connersville, Ind., are under contract to furnish the Boston Gas Company with four of the largest-sized blowers, with engines, made by the Roots Company. This order was obtained through the Roots Company's New York agency.

THE proprietors of the Jamestown (N.Y.) Gas Company have ordered a reduction in the selling rate. We have not been advised as to the exact amount of the concession.

THE following, from the Elizabeth (N. J.) *Herald*, of July 21st, explains itself: "The Metropolitan Gas Light Company's plant of this city was seized yesterday by Sheriff Hicks, and will be sold at public auction on the 24th of next month to satisfy its many creditors, chief among whom is the Central Trust Company, of New York, which holds a mortgage on the plant for $350,000. The suit is brought by the Central Trust Company as complainant, which fact makes all the other creditors, together with the Gas Company, defendants. In other words, it is practically a foreclosure of the mortgage held by the Trust Company, and after the mortgage is satisfied then the other creditors must look out for their interests Among the creditors who have already obtained orders from the Court of Chancery to get their claims liquidated are Messrs. Bartlett, Hayward & Co., $9,736.94; Continental Iron Works, $23,568.76; August Brethauer, $665.50. The total amount of these claims, together with one year's interest added to some of them, will aggregate about $400,000. The Central Trust Company holds 700 of the Company's bonds, bearing interest at the rate of 5 per cent. In addition to the above named having claims against the Company, are the Mostyn Iron Bridge and Roof Company, Messrs. Weber and George M. Morrell, and the Delaware Oil Company. These, for some cause or other, failed to obtain an order from Councellor McGill or Camille Weidenfeld, Receiver for the Gas Company, to pay their claims. It is said, however, that they propose to push them. From the very first day of the Company's inception it has been in difficulty. First over the right to lay its pipes, which right was contested by the old Company, of which Mr. John Kean, Jr., is President. Mr. Kean claimed that the charter was illegal, it having been obtained by special legislation in 1871, 19 years having elapsed before anything was done toward establishing the plant, at which time the charter was sold to a syndicate, of which Charles G. Francklyn, who, it is claimed, is not worth anything in his own name, was President. First the fight was carried to the Supreme Court, then to the Court of Appeals, and as a last resort has been carried by the President of the old Company to the United States Supreme Court. As stated above, the sale of the plant will occur on Aug. 24. The sale includes not only the gas apparatus and mains, but also the corporate rights and franchises it enjoys. Some have an idea that Mr. Kean will buy in the plant at the sale, but others hold differently, asserting that the Trust Company will prevent him from doing so."

THE annual meeting of the St. Paul (Minn.) Gas Light Company was held in this city on the morning of July 27. The meeting was entirely harmonious, as it ought to have been, from the fact that the annual reports reflected a steadily increasing business, at a good profit. The Company determined to add to both its gas and electric plants, and the improvements agreed upon will involve ultimately the expenditure of something like $100,000. This year an additional plot of ground will be purchased, with the purpose of locating thereon a purifying house, to be equipped in accordance with the best principles of modern construction. The main system, work on which is now underway, will be augmented by the placing of 10 miles of pipe, and several minor improvements on plant have been arranged for. The electric division of the Company's system will be enlarged, the main item being the placing of a cross-compound engine of the Allis type, rated to yield 1,150 horse power, nominal. The shafting, etc., will be in accord with the motor that actuates the same. The annual election resulted in the following choices: Directors, Henry Villard, T. F. Okes and C. Livingston; President, Henry Villard; Vice-President and General Manager, C. Livingston; Secretary, Treasurer and General Superintendent, B. F. Ellison.

WE are indebted to "C. A. W." for the following account of the proceedings before the City Council of Manchester, Va., respecting the proposed gas works at that point: "The City Council held a meeting on July 25, to consider the report of the Joint Committee on Light and Ordinances, in regard to the application of Mr. W. J. Winegar and associates for the right to establish a gas plant in Manchester. The report of the Committee, which recommended the granting of the franchise, was freely discussed. Mr. Utz said that, as similar franchises had been granted to other parties, and as they had failed to accomplish anything in the way of erecting a plant, he was in favor of requiring of the present applicants a bond in the sum of $2,000 as a guarantee. He made a motion to that effect, which was adopted. The ordinance was then so amended as to require the Company to put up $2,000 in currency, or a certified check within 60 days as a forfeit, and in case the amount is not deposited in the specified time, the ordinance shall be declared void. The ordinance was then adopted, by a vote of 8 in favor to 1 against."

A HARTFORD (Conn.) citizen was recently asked what would be the result if the Governor of Connecticut should be compelled to order out the Connecticut National Guard for an emergency like that at Pennsylvania, and in his reply, among other things, said—referring to the small arms equipment of the Connecticut militia: "The old Springfield rifles in the armories are no better than so many pieces of old gas pipe. Those that can be fired would bring greater destruction on the men firing them than on their enemies."

THE Consolidated Gas and Electric Light Company, of Portchester, N. Y., will install an incandescent electric light plant.

THE new net rate of $1.50 per 1,000 cubic feet, at Gloucester, Mass., is now in effect. The gross is $2 per 1,000, with 25 per cent. off for cash.

THE share of stock in the old Boston Gas Company, which formed a part of the assets of the late Irving A. Evans, financier, has been sold for $12,000. The par value of the security is $500. The share is said to have been purchased by a gas capitalist of Providence, R. I. Are the chickens coming home to roost?

IT is said that an offer of $120 per share has been made for the entire capital stock of the Nashville (Tenn.) Gas Light Company. The Directors will likely call a special meeting of the shareholders to consider the proposition. Meanwhile, it looks to us that the stock ought to be worth $140 a share, at least.

THE gas war at Fort Scott, Kas., has been brought to a close. As we understand it, the Fort Scott Gas and Fuel Company succeeds to the estate of the Fort Scott City Gas Company, through the purchase of the latter.

AT the annual meeting of the Nantucket (Mass.) Gas Light Company, Mr. A. L. Mowry was re-elected President, and Mr. A. M. Myrick was elected Secretary and Treasurer. It was also voted to charge $2 per 1,000 cubic feet for gas, where the monthly consumption is in excess of 1,000 cubic feet.

THE mortgage issue of $200,000 bonds recently voted by the Directors of the Pulaski Gas Light Company, of Little Rock, has been satisfactorily placed. The New York Guaranty and Indemnity Company is the Trustee. A large portion of the proceeds will be expended in plant betterments and main extensions.

AT the annual election of the Consolidated Gas Company, Baltimore, Md., the following officers were chosen: Directors, E. C. Benedict, W. B. Brooks, Wm. F. Burns, B. Cahn, W. S. Carroll, W. F. Frick, Jas. A. Gary, John W. Hall, Henry James, D. D. Mallory, William W. Spence and C. A. von Lingen; President, John W. Hall; Vice-President, W. S. Carroll; Treasurer, Joseph W. Clarke; Secretary, N. T. Meginnis.

THE East Norwalk (Conn.) Gas Light Company is making several important changes in its main system.

AT the annual meeting of the Duluth (Minn.) Gas and Water Company, the following officers were chosen: President, R. L. Belknap (New York); Vice-President, John H. Upham; Secretary, G. C. Squires (St. Paul); Treasurer, R. B. C. Bement (St. Paul); Superintendent and General Manager, William Craig. Mr. Squires replaces Mr. F. H. Weeks.

SUPERINTENDENT MURPHY is a busy man just now overlooking the changes on the gas works at Sing Sing, N. Y.

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

EDITOR—JOS. R. THOMAS, C.E.
ASST. EDITOR—T. J. CUNNINGHAM.
MANAGER—C. E. Sanderson.

PUBLISHED ON EACH MONDAY OF THE YEAR AT
No. 32 Pine Street, New York.

This is a recognized official organ of
LIGHT, HEAT, STEAM, WATER SUPPLY,
VENTILATION, SANITARY IMPROVEMENT,
AND GENERAL SCIENCE

MONDAY, AUGUST 1, 1892.

The Market for Gas Securities.

The terrible heat of the past week naturally exerted a depressing effect on the business of the Exchange, and gas shares, in common with the rest of the list, were neglected. Consolidated was firmly held at about 115. Other city shares were dull and strong. In Brooklyn shares but little was done, although it is undeniable that the tone of the market is all on the side of strength. Citizens gas is very firm, at 113½ to 113¾, and it is more than likely that the proprietors will shortly authorize Mr. Byrne to make important plant extensions. Chicago gas enjoyed another upward spurt this week, and is now well along to the 83 mark. Consolidated, of Baltimore, moves steadily upward. The Company's gross earnings for the year exceeded those of the previous twelvemonth by $109,000, and the output was increased by 5 per cent. in the same period. Bay State gas is dull and lower.

Advertisers Index.

GAS ENGINEERS. Page

Jos. R. Thomas, New York City..... 177
Wm. Henry White, New York City..... 175
Fred. Bredel, New York City..... 171
H. C. Slaney, New York City..... 177
J. R. Smedberg, Peoria, Ills..... 177

CHEMISTS.

Durand Woodman, New York City..... 159

GAS AND WATER PIPES.

Mellert Foundry and Machine Co., Reading, Pa. (John Fox, Selling Agent, N. Y.)..... 169
Ohio Pipe Co., Columbus, Ohio..... 169
M. J. Drummond, New York City..... 169
R. D. Wood & Co., Phila., Pa..... 169
Warren Foundry & Machine Co., New York City..... 169
Donaldson Iron Co., Emaus, Pa..... 169
Addyston Pipe and Steel Co., Cincinnati, O..... 169
Detroit Pipe and Foundry Co., Detroit, Mich..... 169

PROCESSES.

National Gas Light and Fuel Co., Chicago, Ills..... 166
Bartlett, Hayward & Co., Baltimore, Md..... 173
United Gas Improvement Co., Phila, Pa..... 165
Burdett Loomis, Hartford, Conn..... 175
National Gas and Water Co., Chicago, Ills..... 167
A. M. Sutherland, New York City..... 159

GAS WORKS APPARATUS AND CONSTRUCTION.

James R. Floyd & Sons, New York City..... 175
Continental Iron Works, Brooklyn, N. Y..... 160
Delly & Fowler, Phila., Pa..... 175
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 172
Stacey Mfg. Co., Cincinnati, Ohio..... 175
Bartlett, Hayward & Co., Baltimore, Md..... 173
Morris, Tasker & Co., Limited, Phila., Pa..... 173
Davis & Farnum Mfg. Co., Waltham, Mass..... 172
R. D. Wood & Co., Phila., Pa..... 174
Bouton Foundry Co., Chicago, Ills..... 175
Isbell-Porter Company, New York City..... 174
Fred. Bredel, New York City..... 171
United Gas Improvement Co., Phila., Pa..... 165
National Gas Light and Fuel Co., Chicago, Ills..... 166
Berlin Iron Bridge Company East Berlin, Conn..... 162
National Gas and Water Co., Chicago, Ills..... 167
The Gas Works Construction Co., New York City..... 159

ELEVATORS, CONVEYORS, ETC.

Link-Belt Machinery Co..... 159

STEAM BLOWER FOR BURNING BREEZE.

H. E. Parson, New York City..... 162

GAS COALS.

Penn Gas Coal Co., Phila., Pa..... 177
Perkins & Co., New York City..... 176
Despard Coal Coal, Baltimore, Md..... 177
Chesapeake and Ohio R. R. Coal Agency, N. Y. City..... 177
Westmoreland Coal Company, Phila., Pa..... 177
J. & W. Wood, New York City..... 176

CANNEL COALS.

Perkins & Co., New York City..... 176
J. & W. Wood, New York City..... 176

GAS ENRICHERS.

Standard Oil Co., Cleveland, Ohio..... 177

COKE CRUSHER.

C. M. Keller, Columbus, Ind..... 176

INCLINED RETORTS.

Parker-Russell Mining and Mfg. Co., St. Louis, Mo..... 170

RETORTS AND FIREBRICK.

J. H. Gautier & Co., Jersey City, N. J..... 170
B. Kreischer & Sons, New York City..... 170
Adam Weber, New York City..... 170
Laclede Fire Brick Mfg. Co., St. Louis, Mo..... 170
Brooklyn Retort and Fire Brick Works, Brooklyn, N. Y..... 170
Borgner & O'Brien, Phila., Pa..... 170
James Gardner, Jr., Pittsburgh, Pa..... 170
Henry Maurer & Son, New York City..... 170
Baltimore Retort and Fire Brick Co., Baltimore, Md..... 170
Parker-Russell Mining and Mfg. Co., St. Louis, Mo..... 170

COMPTOMETERS.

Felt & Tarrant Mf'g. Co., Chicago, Ills..... 159

GASHOLDER TANKS.

W. O. Whyte, New York City..... 166
J. P. Whittier, Brooklyn, N. Y..... 164

GASHOLDER PAINT.

The Government Waterproof Paint Co., Boston, Mass..... 162

CEMENTS.

C. L. Gerould & Co., Brooklyn, N. Y..... 170

SCRUBBERS AND CONDENSERS.

G. Shepard Page's Sons, New York City..... 128
R. D. Wood & Co., Phila., Pa..... 174
James R. Floyd & Sons, New York City..... 168
Continental Iron Works, Brooklyn, N. Y..... 160

REGENERATIVE FURNACES.

Bartlett, Hayward & Co., Baltimore, Md..... 173
Fred. Bredel, New York City..... 171
J. H. Gautier & Co., Jersey City, N. J..... 171
Parker-Russell Mining and Mfg. Co., St. Louis, Mo..... 170

GAS GOVERNORS.

Connelly Iron Sponge and Governor Co., New York City..... 167
Wilbraham Bros., Phila., Pa..... 167

TAR AND CARBONIC ACID EXTRACTOR.

Geo. Shepard Page's Sons, N. Y. City..... 164

COAL TAR.

J. W. Ford, Chicago, Ill..... 159

AMMONIA CONCENTRATOR.

Michigan Ammonia Works, Detroit, Mich..... 159

GAS METERS.

John J. Griffin & Co., Phila., Pa..... 178
American Meter Co., New York and Philadelphia..... 179
The Goodwin Gas Stove and Meter Co., Philadelphia, Pa..... 180
Helme & McIlhenny, Phila., Pa..... 179
D. McDonald & Co., Albany, N. Y..... 179
Nathaniel Tufts, Boston, Mass..... 178
Maryland Meter and Manufacturing Co., Baltimore, Md..... 173
Harris Bros. & Co., Philadelphia, Pa..... 178
Keystone Meter Co., Royersford, Pa..... 179

COUPON CUTTERS.

Felt & Tarrant Mf'g. Co., Chicago, Ills..... 159

SELF-SEALING MOUTHPIECE DOORS.

Isbell-Porter Company, New York City..... 174
Continental Iron Works, Brooklyn, N. Y..... 165

BURNERS.

C. A. Gefrorer, Phila., Pa..... 169
Moses G. Wilder, Phila., Pa..... 159
Non-Corrosive Gas Tip Co., Boston, Mass..... 123

STREET LAMPS.

J. G. Miner, Morrisania, New York City..... 171
Bartlett Street Lamp Mfg. Co., New York City..... 171

PURIFYING MATERIAL.

Connelly Iron Sponge and Governor Co., New York City..... 167
Greenpoint Chemical Works, Brooklyn, N. Y..... 167
Henry W. Douglas, Ann Arbor, Mich..... 167

ELECTRICAL APPARATUS.

Wm. Henry White, N. Y. City..... 175
Fort Wayne Electric Co., Fort Wayne, Ind..... 168
Weston Electrical Instrument Co., Newark, N. J..... 169

EXHAUSTERS.

The P. H. & F. M. Roots Co., Connersville, Ind..... 164
Isbell-Porter Company, New York City..... 174
Wilbraham Bros., Philadelphia, Pa..... 167
Connelly Iron Sponge and Governor Co., New York City..... 167

VALVES.

Ludlow Valve Manufacturing Co., Troy, N. Y..... 159
Chapman Valve Manufacturing Co., Boston, Mass..... 169
R. D. Wood & Co., Phila., Pa..... 174
The P. H. & F. M. Roots Co., Connersville, Ind..... 198
Continental Iron Works, Brooklyn, N. Y..... 160

GAS ENGINES.

Schleicher, Schumm & Co., Phila., Pa..... 144

ENGINES AND BOILERS.

The Hazelton Boiler Co., New York City..... 160

PURIFIER SCREENS.

John Cabot, New York City..... 169

GAS STOVES.

American Meter Co., New York and Philadelphia..... 163
The Goodwin Gas Stove and Meter Co., Phila., Pa..... 180
George M. Clark & Co., Chicago, Ills..... 161
Maryland Meter and Manufacturing Co., Baltimore, Md..... 178

WANTED,

Young man of technical education as

Chemist and General Assistant

in a gas works in a Central Western city. Address, with references and statement of collegiate or practical experience,

895-2 "T. X.," care this Journal.

WANTED,

Gas Manager for Small Works.

Confidential. Address, with full particulars,

893-3 "X.," P. O. Box 1247, Boston, Mass.

NOTICE.

THE BRECKENRIDGE COMPANY, LIMITED.

This Company has now no Agents. Orders for the Company's celebrated Cannel should be sent to WM. HOPPER, Resident Director, Kentucky National Bank Building, Louisville, Ky., who will supply the fullest information.

The Breckenridge & Pineville Syndicate, Limited.

PINEVILLE BOGHEAD.—Orders for this Cannel should be sent to WM. HOPPER, Trustee, Room 60, Kentucky National Bank Building, Louisville, Ky. Particulars of analysis and yield of gas upon application. 894-5

FOR SALE,

A Connelly Six-Inch Jet Exhauster,

In first-class condition, only two years used.

Apply to the BERGEN COUNTY GAS LT. COMPANY,

894-4 Englewood, N. J.

Position Wanted

A man of 40, having extensive experience as manager, engineer, and superintendent of construction and operations in detail for

Gas, Electric, Water and Rapid Transit Plants,

wishes a position with a reliable Company or Firm. Is sober, active and reliable, and a thorough, practical and skilled mechanic, with a good knowledge of inventions and improvements. First-class references given and required. Address

891-9 "H. O. C.," care this Journal.

FOR SALE.

Six Oil Tanks, 4 ft. diameter by 30 ft. long.
One Oil Tank, 5 ft. diameter by 26 ft. long
One Station Meter, 500,000 cu ft. capacity.

All the above in good condition. Further particulars may be had by addressing THE NEW HAVEN GAS LT. CO.,

889-tf New Haven, Conn.

FOR SALE,

An 8-inch Hopper Gas Governor.

Good as new. Reason for selling, no use for it. Address

893-3 GAS COMPANY, West Chester, Pa.

For Sale, Cheap.

Four Cast Iron Purifiers, 8 ft. x 6 ft. x 42 in., inside measurement.
Six Wrought Iron Purifier Covers, 2 Hoists, Center Seal and all 8-in. connections and supports.
One Station Meter, 4 ft. x 4 ft. Bye-Pass and all fittings, 8 in.
Two 8-inch Valves and Two 8-inch Bye-Passes.
One 6-inch Foulis Patent Governor.

All in good order. For further information address

J. C. RAWN, Mangr. & Engr.,
893-4 Roanoke Gas & Water Co., Roanoke, Va.

Coal Tar For Sale.

THE DETROIT GAS LIGHT CO.

Offers for sale its product of

PURE COAL TAR,

made from Pittsburgh coal. About 160,000 gallons per year, for a term of one, three, or five years. Delivery in tank cars, Wabash R. R. tracks. Proposals will be received until Aug. 4, 1892, and should be addressed to

ISAAC C. BAXTER, Engr. Detroit Gas Lt. Co.,
892-4 Detroit, Mich.

DURAND WOODMAN, Ph.D.,

Analytic and Technical

CHEMIST.

Fuel and Gas Coals, Gas, Materials for Purification, Water, etc.

Laboratory, 127 Pearl (80 Beaver) St., N. Y.

Coal Tar.

J. W. FORD,

153 Washington Street, Chicago, Ill.,

Is always ready to buy Coal Tar.

THE GAS WORKS CONSTRUCTION CO.

ENGINEERS AND CONTRACTORS

FOR THE

Erection of New or the Rebuilding of Old Works.

LAYING of CAST or WROUGHT IRON STREET MAINS.

Special Attention Paid to the Building of Holder Tanks.

Plans, Specifications and Estimates Furnished on Application.

2, 4 & 6 College Place, Room 7, N.Y.

Utilize Your Gas Liquor.
NO EXTRA LABOR OR OPERATING EXPENSES.

Ammonia Concentrator.

Not Expensive. Write to
STROH & OSIUS, Pat'ees, or Mich. Ammonia Works, Detroit, Mich.

MOSES G. WILDER, MECH. ENGR.

816-18-20-22 Cherry St., Phila., Pa.

Volumetric Lamp Governors

Governor Burners for Street Lamps & General Use

GOVERNORS FOR ARGAND AND OTHER COMMON GAS BURNERS IN ALL SIZES.

Horizontal Governors

Specially Adapted for Gas Stoves, Furnaces, etc.

It is well known that a large majority of all High Power Gas Lamps in the United States have my Governors attached, and they are always used by the leading makers of these lamps. To remove any excuse for the use by anyone of inferior and infringing Governors, a reduction in price has been made, and all exclusive contracts are cancelled.

Correspondence Solicited with all who require a Reliable Governor.

TRANSMISSION of POWER

BY MANILLA ROPE.

Copiously illustrated and described in Catalogue just issued.

LINK-BELT MACHINERY CO., - CHICAGO.

Gas Bills

are receipted, dated and their Coupon cut off and delivered, dated, by one blow on the

COUPON CUTTER

Write for Pamphlet.

FELT & TARRANT MFG. CO. 52 to 56 Illinois St. **CHICAGO.**

MR. BOOKKEEPER, do you know what the Comptometer is? It costs you nothing to find out. If it costs you out on that trial balance, if you out accuracy, is twice as rapid as the best accountant and rapid insures nervous and mental strain. relieves all

Write for pamphlet.
FELT & TARRANT MFG. CO.,
52-56 Illinois Street, Chicago.

THE "LITTLE GIANT" WATER GAS GENERATOR.

In order to correct some of the drawbacks in existing apparatus, and to bring Water Gas Generators within the reach of all Gas Companies, I have completed a Gas Generator (which can be seen in daily operation) having many advantages over all others.

This Generator takes but little room. It requires no change to be made in the height or depth of gas houses. It is more easily repaired when necessary. It is simpler and easier operated. It makes *more good gas from a given quantity of stock.* It makes good gas from *cheaper stock.* It makes gas of *any desired candle power* up to thirty without smoke. It makes a faultless gas from whatever gas-producing materials are cheapest in the locality where required, using hard coal or coke in connection with Lima crude or any other crude petroleum or its distillates, including *Naphtha of any specific gravity.* I build these Generators with any required capacity from 3,000 cubic feet per hour upward.

In more than one-half the gas works in the country the "Little Giant" will enable *one man* to easily make, in *five hours,* all the gas needed for the *twenty-four* hours.

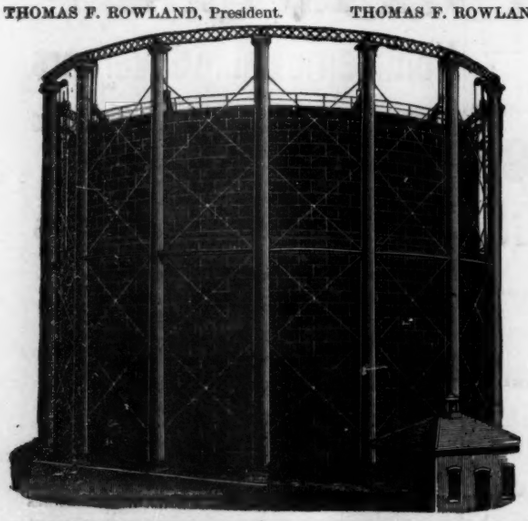
I have decided to take orders for these Generators for the balance of this season at *one half the price of any other* Water Gas Generator of equal capacity now on the market. After that the price shall be raised. *Everything is guaranteed,* including durability and capacity of the Generator, the quality of the gas, and its cost.

Correspondence solicited.

A. M. SUTHERLAND, - - No. 115 Broadway, N. Y. City.

The Continental Iron Works

THOMAS F. ROWLAND, President. THOMAS F. ROWLAND, Jr., Secretary & Treasurer. WARREN E. HILL and CHAS. H. CORBETT, Vice-Presidents.



BROOKLYN, N. Y.

TAKE EAST TENTH OR TWENTY-THIRD STREET FERRIES FROM NEW YORK TO GREENPOINT.

BUILDERS OF

GAS HOLDERS.

Single and Multiple Section Gas Holders a Specialty.

Wrought Iron Gas Holder Tanks.

BENCH CASTINGS, RETORT LIDS.

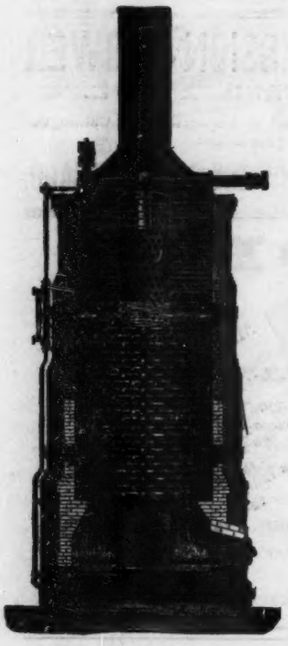
Hydraulic Mains, Condensers, Scrubbers. Purifiers, Valves, Etc., Etc.

SELF-SEALING RETORT MOUTHPIECES & LIDS

For Round, Oval, or "D" Retorts.

THE HAZELTON BOILER.

The Handiest, Safest, and Most Economical Boiler.



THE HIGHEST STANDARD OF EXCELLENCE.

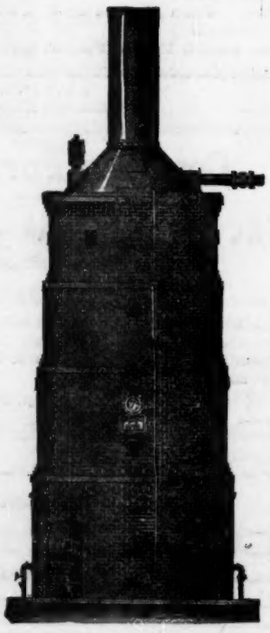
Patented in the United States and Foreign Countries.

THREE REGISTERED

THE HAZELTON BOILER.

THE PORCUPINE BOILER.

TRADE MARKS.



All Genuine Hazelton or Porcupine Boilers bear our Three Registered Trade Marks.

BEWARE OF IMITATIONS.

THE HAZELTON BOILER CO.,

MANUFACTURERS AND SOLE PROPRIETORS,

General Office, 716 E. Thirteenth St.; Works, Avenue D and Thirteenth St., **New York, U.S.A.**

This Company is prepared to furnish Plants of Boilers of any desired capacity; solicits inspection of those now in operation, and will forward proposals and other information on application. All imitations of the substantial features of this boiler are infringements, and will be prosecuted to the full extent of the law. *Correspondence Solicited.*

The following are a few of the Gas Companies using this Boiler:

THE NEW YORK MUTUAL GAS LIGHT COMPANY.....New York City.	ST. PAUL GAS LIGHT COMPANY.....St. Paul, Minn.
THE NORTH ADAMS GAS LIGHT COMPANY.....North Adams. Mass.	NEWARK GAS LIGHT COMPANY.....Newark, N. J.
THE BOSTON GAS LIGHT COMPANY.....Boston, Mass.	THE NORTHERN GAS LIGHT COMPANY.....New York City.
CONSOLIDATED GAS COMPANY.....New York City.	NASSAU GAS LIGHT COMPANY.....Brooklyn, N. Y.
CONSOLIDATED GAS AND ELECTRIC COMPANY.....Port Chester N. Y.	MILWAUKEE GAS LIGHT COMPANY.....Milwaukee, Wis.
HUDSON COUNTY GAS LIGHT COMPANY.....Hoboken, N. J.	PITTSBURGH GAS LIGHT COMPANY.....Pittsburgh, Pa.
HAVERHILL GAS COMPANY.....Haverhill, Mass.	MUTUAL FUEL GAS COMPANY.....Chicago, Ill.

Coal Tar Genealogical Tree

MR. T. VINER CLARKE, of London, Eng., having compiled a novel Chart or Map illustrating the various

CHEMICAL PRODUCTS DERIVED FROM COAL AND COAL TAR,

In the form of a Genealogical Tree, including all the products discovered to date (the total number amounting to near 700), offers for sale a limited number of copies in Colors, mounted on Linen, with Rollers. Price, $3.50. Orders may be sent to

A. M. CALLENDER & CO., - - No. 32 Pine Street, New York.

Jewel Gas Stoves

ARE THE BEST.

MADE IN FIFTY-SEVEN STYLES.

Prices from 75 Cents to $66.00.

For Details we refer to the Jewel 1892 Catalog.

JEWEL FEATURES ARE:

Burners with Sawed Slots. Direct Needle Valves.

Good Mechanical Construction.

GEORGE M. CLARK & COMPANY,

Makers,

157-161 Superior Street,

CHICAGO.

SCIENTIFIC BOOKS.

KING'S TREATISE ON THE MANUFACTURE OF COAL GAS. Three vols.; $10 per vol.

GAS MANUFACTURE, by WILLIAM RICHARDS. 4to., with numerous Engravings and Plates, in Cloth binding. $12.

TECHNICAL GAS ANALYSIS. $3.

GAS CONSUMER'S GUIDE. $1.

GAS CONSUMER'S HANDBOOK, by WILLIAM RICHARDS, C.E.; 18mo., Sewed. 20 cents.

A PRACTICAL TREATISE ON GAS AND VENTILATION with Special Relation to Illuminating, Heating, and Cooking by Gas, by E. E. PERKINS. $1.25.

CHEMISTRY OF ILLUMINATING GAS, by NORTON H. HUMPHRYS. $2.40.

PRACTICAL TREATISE ON HEAT, by THOMAS BOX. Second edition. $5.

STRAINS IN IRONWORK, by H. ADAMS. With plates. $1.75

GAS WORKS—THEIR ARRANGEMENT, CONSTRUCTION, PLANT, AND MACHINERY. $8.

COAL; ITS HISTORY AND USE, by PROF. THORPE. $3.50.

THE GAS WORKS OF LONDON, by COLBURN. 60 cents.

HEAT A MODE OF MOTION, by JOHN TYNDALL. $2.50.

MUNICIPAL LIGHTING, by F. H. WHIPPLE. $1.

THE MANAGEMENT OF SMALL GAS WORKS, by C. J. B. HUMPHREYS. $1.

MANUAL FOR GAS ENGINEERING STUDENTS, by D. LEE, 40 cents.

THEORY OF HEAT, by J. CLERK-MAXWELL. $1.25.

THE DOMESTIC USES OF COAL GAS, AS APPLIED TO LIGHTING, by W. SUGG. $1.40.

DIGEST OF GAS LAW. $5.

DISTILLATION OF COAL TAR AND AMMONIACAL LIQUOR, by GEO. LUNGE. New Edition. $12.50.

A TREATISE ON THE COMPARATIVE COMMERCIAL VALUES OF GAS COALS AND CANNELS, by D. A. GRAHAM 8vo., Cloth. $3.

GAS COMPANIES DIRECTORY, 1891. $5.

THE AMERICAN GAS ENGINEER AND SUPERINTENDENT'S HANDBOOK, by WM. MOONEY. $3.

GAS ENGINE INDICATOR DIAGRAM, by W. E. AYRTON. Paper. 20 cents.

ILLUMINATING AND HEATING GAS, by W. BURNS. $1.50.

NOTES IN MECHANICAL ENGINEERING, by H. ADAMS. $1.

NEWBIGGING'S HANDBOOK FOR GAS ENGINEERS AND MANAGERS, by THOS. NEWBIGGING. Fifth edition. $6.

A TREATISE ON MASONRY CONSTRUCTION. BARKER. $5

FUEL AND ITS APPLICATIONS. $7.50.

ELECTRICITY.

THE ELEMENTS OF ELECTRIC LIGHTING, Including Electric Generation, Measurement, Storage, and Distribution, by PHILIP ATKINSON. $1.50.

ELEMENTARY ELECTRICITY, by PROF. F. JENKIN. 40 cts.

ELECTRIC TRANSMISSION OF ENERGY, by G. KNAPP. $2.

ARC AND GLOW LAMPS, by J. MAIER. Illustrated. $3.

ELECTRICIAN'S POCKET-BOOK, by MONROE and JAMIESON. $2.50.

MAGNETISM AND ELECTRICITY, by J. OVEREND. 40 cents.

ACCUMULATORS, by SIR D. SALOMONS. $1.20.

DYNAMO BUILDING, by F. W. WALKER. 80 cents.

ELECTRICAL TABLES AND FORMULÆ, by L. CLARK and R. SABINE. $5.

ELECTRIC LIGHTING FROM CENTRAL STATIONS, by G. FORBES. Paper. 40 cents.

ELECTRIC LIGHT PRECAUTIONS, by K. HEDGES. Illustrated. $1.

SUPPLY OF ELECTRICITY BY LOCAL AUTHORITIES, by K. HEDGES. Paper. 40 cents.

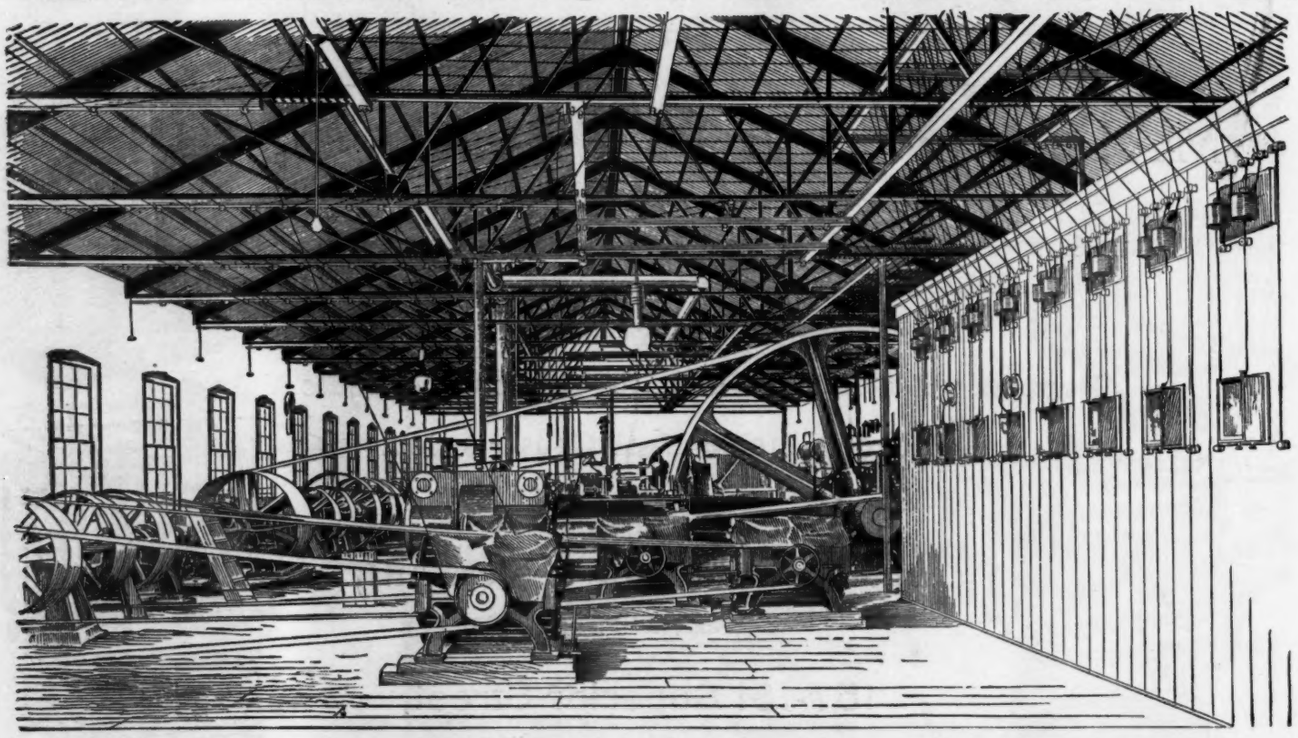
DOMESTIC ELECTRICITY FOR AMATEURS, by E. HOSPITALIER. $3.

The above will be forwarded by express, upon receipt of price. If sent by mail, postage must be added to above prices. We take especial pains in securing and forwarding any other Works that may be desired, upon receipt of order. All remittances should be made by check, draft, or post office money order.

A. M. CALLENDER & CO., 32 Pine Street, New York.

CHAS. M. JARVIS, Prest. & Chief Engineer BURR K. FIELD, Vice-President. FRANK L. WILCOX, Treasurer. GEO. H. SAGE, Secretary

THE BERLIN IRON BRIDGE CO.



The above illustration is taken direct from a photograph, and shows the construction of an Iron Truss Roof designed and built by us for the Connecticut Electric Company, at Waterbury, Conn. The building is 51 feet in width by 251 feet in length, with brick walls and Iron Truss Roof covered with corrugated iron. For an Electric Light Station, where the risk from fire is very great, this construction particularly commends itself, as this risk is entirely eliminated.

Write for Illustrated Catalogue.

Office and Works, No. 6 Railroad Avenue, East Berlin, Conn.

GASHOLDER PAINT.

Use Only

THE GOVERNMENT WATERPROOF PAINT.

Proof against Ammonia, and Absolutely Waterproof. Send for Prices and Particulars.

THE GOVERNMENT WATERPROOF PAINT CO., 104 High Street, Boston, Mass.

Parson's Steam Blower,

FOR IMPROVING BAD DRAUGHT IN BOILERS, AND FOR BURNING BREEZE OR OTHER WASTE MATERIAL.

PARSON'S TAR BURNER,

FOR UTILIZING COAL TAR AS FUEL.

PARSON'S AIR JET TUBE CLEANER,

FOR CLEANING BOILER TUBES.

These devices are all first-class. They will be sent to any responsible party *for trial*. No sale unless satisfactory. Manufactured by the WATERTOWN STEAM BLOWER COMPANY.

H. E. PARSON. Supt., No. 54 Pine St., N. Y.

BINDER for the JOURNAL.

STRONG.

DURABLE.

LIGHT.

SIMPLE.

CHEAP.

HANDSOME.

Price, $1.

A.M. Callender & Co., 32 Pine st., N. Y. City.

Fuel and Its Applications

By E. J. MILLS, D.Sc. F.R.S., and F. J. ROWAN, C.E., assisted by others, including Mr. F. P. Dewey, of the Smithsonian Inst., Wash., D. C.

7 PLATES, AND 607 OTHER ILLUSTRATIONS. ROYAL OCTAVO, PAGES XX, 802. HANDSOME CLOTH, $7.50.

A. M. CALLENDER & CO., 32 Pine St., N. Y.

NEWBIGGING'S HANDBOOK FOR GAS ENGINEERS AND MANAGERS.

The present (the fifth) edition marks an important advance on those that have gone before. Considerable additions have been made to the text, and much of it has been rewritten and otherwise improved. Price, cloth, $6. A. M. CALLENDER & CO., 32 Pine St. N. Y.

THE AMERICAN METER CO.

Established 1834. Incorporated 1863.

MANUFACTURERS OF

Standard 3 Diaphragm Dry Meter.

Gas Meters,

STATION METERS,

METER PROVERS, PHOTOMETERS,

Experimental Meters of all Kinds,

AND

Standard 2 Diaphragm Dry Meter.

Apparatus for Testing the Quantity and Quality of Gases.

GAS STOVES

OF ALL SIZES AND FOR ALL PURPOSES.

Catalogues showing New Designs will be sent upon application.

MANUFACTORIES,

508 to 514 West Twenty-second St., N. Y. Arch and Twenty-second Sts., Phila. 125 & 127 S. Clinton St., Chicago.

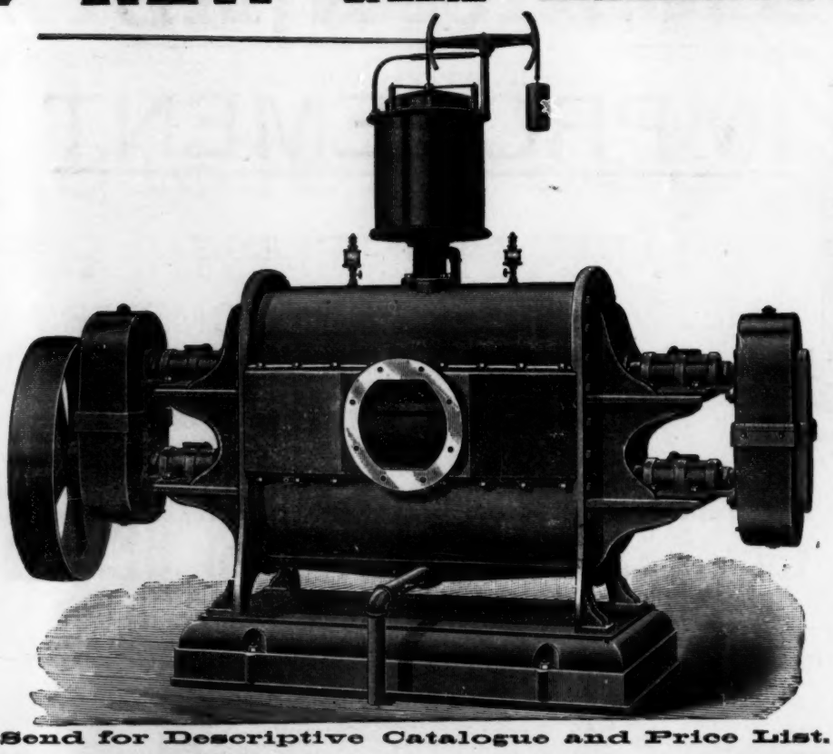
AGENCIES,

No. 177 Elm Street, Cincinnati, Ohio. No. 222 Sutter Street San Francisco Cal.
No. 810 North Second Street, St. Louis, Mo.

GAS STOVE SHOW ROOMS, 242 Sixth Avenue, New York City.

ROOTS' NEW GAS EXHAUSTER.

Unsurpassed for Neatness of Design, Durability, Simplicity, Efficiency, and Economy of Power.



All Parts Requiring Attention are External and Easily Accessible at all Times.

Send for Descriptive Catalogue and Price List.

THE P. H. & F. M. ROOTS CO., Patentees and Manufacturers, **CONNERSVILLE, IND.**

S. S. TOWNSEND, Gen. Agts., COOKE & CO., Selling Agts., 163 & 165 Washington St., N. Y.

THE WALKER TAR AND CARBONIC ACID EXTRACTOR.

A very general demand exists, in both large and small Gas Works, for an apparatus that will be absolutely efficient in the removal of the Tar which passes the hydraulic main and condenser. Many attempts have been made to accomplish this, but, I believe, without success, until the introduction, six years ago, in England, of the C. & W. Walker Patent Tar and Carbonic Acid Extractor. During these years this apparatus has been adopted by many of the most prominent Engineers, not only in England, but also on the Continent of Europe and in other parts of the world. Several have been erected in the United States.

"The C. & W. Walker Tar and Carbonic Acid Extractor has been in operation at these works for the past six weeks, and is an unqualified success. It removes every particle of Tar from the gas in once passing through the apparatus, and a large percentage of the Carbonic Acid. I also feel quite sure that it prevents the formation and deposit of Naphthaline, because since I started the Washer I have had no stoppages from this cause. These works have been seriously troubled with Tar for many years, and I have used several kinds of apparatus and every expedient which has come to my attention for dealing with the difficulty, but without success. The Walker apparatus occupies comparatively small space, is less expensive than other systems, and requires but little attention. I carry 2½-inch seal, and have an automatic tar delivery valve. This Tar Extractor is indispensable to gas makers.

"C. A. GERDENIER, Supt. Bridgeport (Conn.) Gas Lt. Co."

This Tar Extractor will perform its work with about one-fourth the usual back-pressure heretofore required. It is simple in construction, and can be supplied at a very reasonable price—less than any other ever before introduced. Satisfactory results guaranteed in every instance.

GEO. SHEPARD PAGE'S SONS, Sole Agts. for Western Hemisphere, 69 Wall St., N. Y.

Gasholder Tanks & Gas Works Masonry Complete.

PLANS PREPARED AND ESTIMATES FURNISHED AT SHORT NOTICE.

J. P. WHITTIER, 70 Rush St., near Division Av., Brooklyn, N. Y.

A Large Quantity of Ground Fire Brick For Sale Cheap.

1892 DIRECTORY 1892

OF AMERICAN GAS COMPANIES.

Price, - - - - - - - - - $5.00.

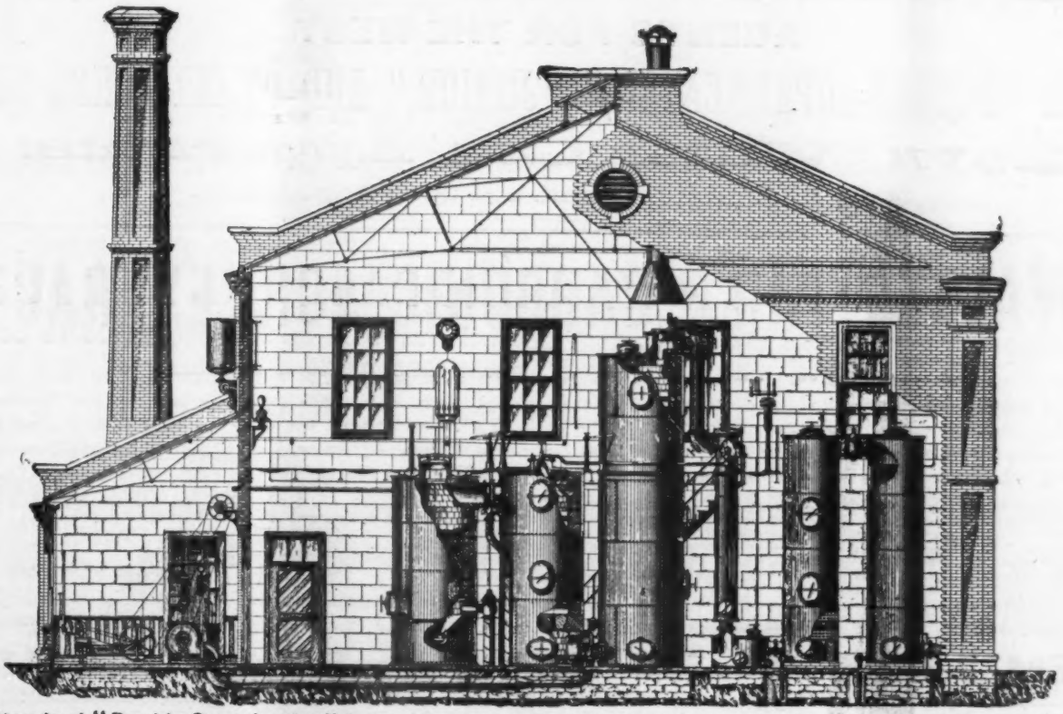
A. M. CALLENDER & CO., - - No. 32 Pine Street, New York.

THE UNITED GAS IMPROVEMENT CO.,

DREXEL BUILDING, PHILA., PA.

Owners of the Lowe, Granger-Collins, McKay-Critchlow (for carbureting Natural Gas), and Other Gas Patents.

BUILDERS, LESSEES and PURCHASERS OF GAS WORKS.



Standard "Double Superheater" Lowe Apparatus, Especially Designed for the Use of Lima Crude Oil.

Erectors of

WATER GAS PLANTS,

(Either Independent or Auxiliary to Coal Gas Works),

USING LIMA OR OTHER LOW GRADE OILS AND ANTHRACITE COAL OR GAS HOUSE OR OVEN COKE

PAMPHLETS, PLANS, AND ESTIMATES FURNISHED UPON APPLICATION.

NATIONAL
GAS LIGHT AND FUEL CO.,

No. 52 Lake Street, Chicago.

FRED'K H. SHELTON, Manager.

GAS WORKS

Built, Remodeled, Leased, or Purchased.

Sole Builders OF THE Springer Cupola System,

Including Solid Arch, "Sliding" or "Bye-Pass" Combustion Valve Forms, and all Modern Improvements.

Also, by Special Arrangement with the United Gas Improvement Company,

AGENTS FOR THE WEST

FOR THE "DOUBLE-SUPERHEATER," "JUNIOR," AND OTHER FORMS OF THE

Lowe Water Gas Apparatus.

Full Information Furnished upon Application.

GASHOLDER TANK CONSTRUCTION, ETC.

Gas Companies and others about to erect Gasholders will find it profitable to consult W. C. Whyte, who for over 30 years has made a specialty of

Tank Excavation and Mason Work.

Fifty Tanks now in operation show the sort of work done. Address

W. C. WHYTE, - - - No. 15 Cortlandt Street, N. Y. City.

NATIONAL GAS AND WATER CO.,

218 La Salle St., Chicago, Ill.

C. D. HAUK, President. HENRY C REW, Vice-Pres't. N. A McCLARY, Secretary. IRWIN REW, Treasurer. E. E. MORRELL, Engineer.

BUILDERS AND OPERATORS OF

Gas Works and Water Works.

WATER GAS APPARATUS A SPECIALTY.

Guaranteed Estimates of Cost of Gas in Holder Furnished upon Application.

CONNELLY IRON SPONGE AND GOVERNOR CO.,

(Successors to CONNELLY & CO.)

MANUFACTURERS OF GAS WORKS SPECIALTIES.

"IRON SPONGE." Saves money, saves labor, and is the most efficient purifying material ever offered as a substitute for lime. We guarantee a large saving, both in cost of material and labor.

AUTOMATIC GOVERNOR.

OVER FOUR HUNDRED NOW IN USE! NO WORKS COMPLETE WITHOUT IT!
WILL PAY FOR ITSELF WITHIN A YEAR! ITS SERVICE SECURES PERFECT DISTRIBUTION!
REDUCES LEAKAGE TO MINIMUM, and BENEFITS THE COMPANY and CONSUMER ALIKE!
IT IS THE ONLY RECOGNIZED AUTOMATIC GOVERNOR IN THE WORLD!

STEAM JET EXHAUSTER. Designed particularly for small works. Combines Exhaust Tube, Steam Governor, Gas Compensator and Bye-Pass Valves in the most compact form possible. Occupies but little space; uses very little steam; saves formation of carbon in retorts; increases yield 10 to 15 per cent. No works too small to use them profitably.

Prices given on all our specialties, delivered at any point in the United States. Correspondence solicited.

CONNELLY IRON SPONGE AND GOVERNOR CO., No. 351 Canal St., New York.

WILBRAHAM
GAS EXHAUSTER & ENGINE COMBINED.

WILBRAHAM BROS.,

PHILADELPHIA, PA.

IRON MASS

For Gas Purification.

Acts immediately, and more efficiently than any other purifying agent now in use.

Greenpoint Chemical Works.

JOHN SCHRIEVER, Manager.

Greenpoint Ave. & Newtown Creek, Brooklyn N.Y.

DOUGLAS' FERRIC OXIDE

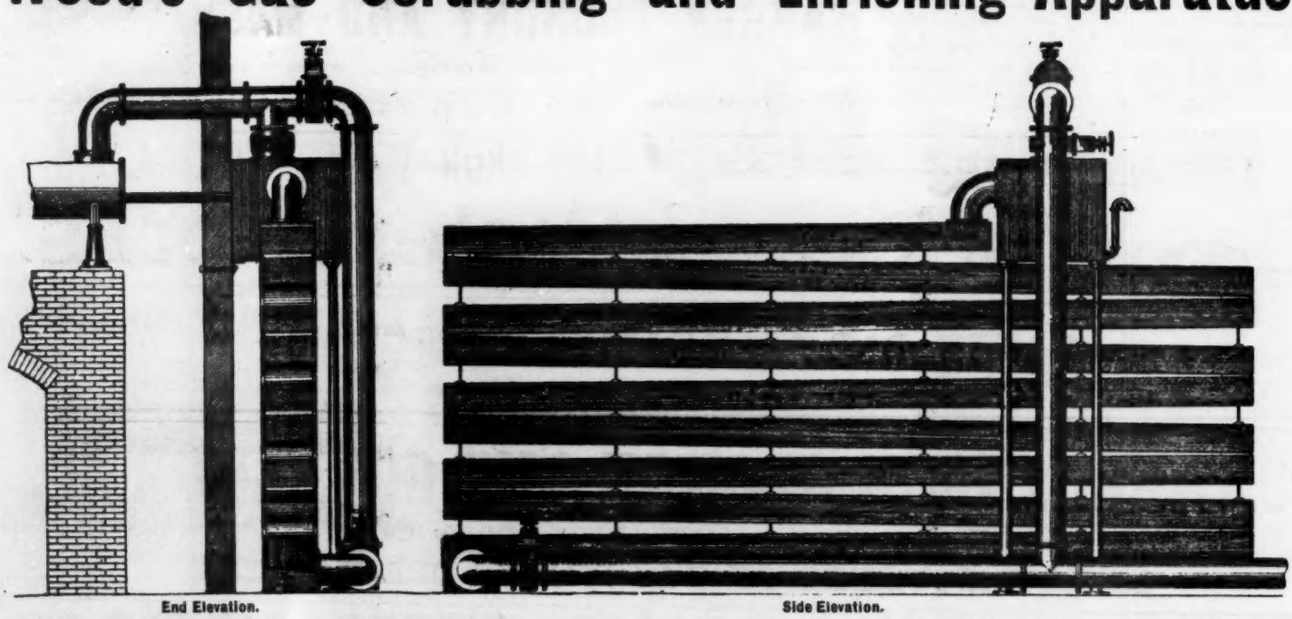
For Gas Purification

Is a superior natural Hydrated Oxide of Iron. Will give a higher purification per bushel than any other material. We ship the pure Oxide of Iron, containing no sawdust, thus effecting a saving in freight, leaving the consumer to furnish the diluent at a nominal cost. It is now used by the largest gas companies in the West.

Full information, with references to many users, and prices delivered in any locality, furnished on application to

H.W. Douglas (Supt. Ann Arbor Gas Company) **Ann Arbor Mich.**

Wood's Gas Scrubbing and Enriching Apparatus.



End Elevation. Side Elevation.

The cheapest, simplest, and most effective apparatus for removing Tar and Ammonia, and enriching Gas, ever brought to the attention of Gas Manufacturers. With ordinary condensers and scrubbers the condensable illuminants flow off to the tar wells and liquor tanks and are lost, but with Wood's Apparatus these illuminants are saved and retained in the gas, thus increasing its illuminating power and making a great saving in the cost of enriching material. Where set up next after the Hydraulic main, this Scrubber produces an 8-oz. Ammoniacal Liquor.

JAMES R. FLOYD & SONS, - - Nos. 531 to 543 West 20th Street, N. Y. City.

FORT WAYNE ELECTRIC CO.

FORT WAYNE, IND.

MANUFACTURERS OF THE

Slattery Induction System

—OF—

LONG DISTANCE INCANDESCENT LIGHTING.

The Most Carefully Worked Out and Complete Alternating Current System of Electric Lighting in Existence.

Wood Dynamo.

—AND THE—

WOOD

Automatically Regulating

ARC DYNAMOS AND LAMPS.

Main Office and Factory, Fort Wayne, Ind.

BRANCH OFFICES.

NEW YORK,	42 & 44 Broad Street.	PITTSBURGH, PA.,	533 Wood Street.
PHILADELPHIA,	907 Filbert Street.	DALLAS, TEXAS,	McLeod Building.
CHICAGO,	185 Dearborn Street.	TORONTO, CANADA,	138 King Street, West.
SAN FRANCISCO	35 New Montgomery Street.	MEXICO, F Adams' Successors,	City of Mexico.
BUFFALO	228 Pearl Street.	CUBA, Maicas & CO.,	Havana.

ENGINEERS. GAS AND WATER PIPES. GAS AND WATER PIPES.

P. D. WANNER, Chairman. A. H. MELLERT, Mangr. of Wks.
R. B. KINSEY, Secretary. F. A. KNOPP, Treasurer.

MELLERT FOUNDRY & MACHINE CO. Ltd. and READING FOUNDRY CO., Ltd.

Reading, Pa.

Specials—Flange Pipe, Valves and Hydrants Lamp Posts, Retorts, etc.

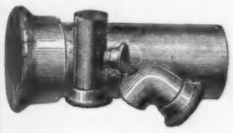
General Foundry and Machine Work.

JOHN FOX, Selling Agent. **160 Broadway, N.Y.**

WARREN FOUNDRY AND MACHINE CO.,

Established 1856. Works at Phillipsburgh, N. J.

New York Office, 160 Broadway.



CAST IRON WATER AND GAS PIPE,

FROM THREE TO FORTY-EIGHT INCHES DIAMETER. ALSO, ALL SIZES OF

Flange Pipe for Sugar House and Mine Work. Branches, Bends, Retorts, etc., etc.

THE OHIO PIPE COMPANY,

MANUFACTURERS OF

Cast Iron Gas & Water Pipe,

BRANCH AND SPECIAL CASTINGS.

Gas-House Bench Castings, Hydraulics, Lamp Posts, Flange Pipe and Specials, Architectural Castings, Building Columns, Joists, Cellar Grates, Sash Weights, etc.

GENERAL FOUNDERS AND MACHINISTS.

Columbus, Ohio.

M. J. DRUMMOND,

SPECIAL CASTINGS AND LAMP POSTS.

Office, Corbin Building, 192 Broadway, N. Y.

EMAUS PIPE FOUNDRY.

DONALDSON IRON COMPANY. EMAUS, PA

MANUFACTURERS OF

CAST IRON PIPE AND SPECIAL CASTINGS

FOR WATER AND GAS.

THE ADDYSTON PIPE AND STEEL COMPANY.

CAST IRON **CINCINNATI, OHIO.**

PIPE FOR MANUFACTURED AND NATURAL GAS AND WATER.

SPECIALS, FLANGE PIPE, AND LAMP POSTS

To Gas Companies.

We make to order **CAP BURNERS** to burn any amount under a stated pressure. Send for samples.

Also, SERVICE CLEANERS, DRIP PUMPS, and STREET MAIN PROVING APPARATUS.

C. A. GEFRORER,
248 N. 8th St., Phila., Pa.

JAS. McMILLAN, Prest. HUGH McMILLAN, Vice-Prest. W. C. McMILLAN, Sec. & Treas. J. H. WHITING, Gen. Supt.

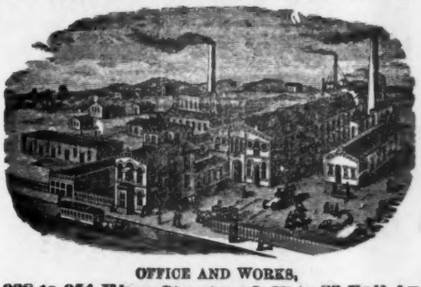
DETROIT PIPE & FOUNDRY CO.,

DETROIT, MICH.

Flange Pipe, Branches & Special Castings.

GENERAL FOUNDRY WORK.

LUDLOW VALVE MFG. CO.



OFFICE AND WORKS,
938 to 954 River Street and 67 to 83 Vail Av., TROY, N. Y.

Hydraulic Main Dip Regulators, also Check Valves, Foot Valves, Yard-wash and Fire Hydrants.

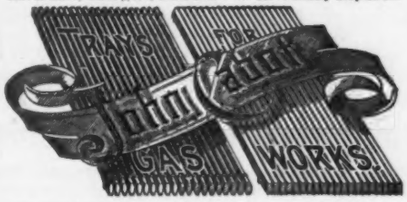
Send for Circulars.

Valves.—Double and Single Gate, ¾ In. to 48 in., outside and inside Screws. Indicator, etc., for Gas, Water, Steam, and Oil. *Send for Circulars.*

Special Trays for Iron Sponge or Oxide of Iron.

CHURCH'S TRAYS a Specialty.

Reversible, Strongest, Most Durable. Most Easily Repaired.



306-310 Eleventh Avenue, New York.

We also make the Cheapest and Strongest REVERSIBLE BOLTED TRAYS IN THE MARKET.

Send for Circulars.

The Weston Standard

VOLTMETERS AND AMMETERS.

These Instruments are the most accurate, reliable, and sensitive portable instruments ever offered. A large variety of ranges, to meet the requirements of all kinds of work.

Send for Catalogue.

Weston Electrical Instrument Co.,

Office & Factory, 114-120 William St, Newark, N. J.

CHAPMAN VALVE MANUFACTURING CO.,

MANUFACTURERS OF

Valves and Gates for Gas, Ammonia, Water, Etc.

Also, Gate Fire Hydrants With and Without Independent Nozzle Valve. All Work Guaranteed.

WORKS & GEN'L OFFICE: **Indian Orchard, Mass.**

TREASURER'S OFFICE: **72 Kilby & 112 Milk Sts, Boston, Mass**

RETORTS AND FIRE BRICK. RETORTS AND FIRE BRICK. RETORTS AND FIRE BRICK.

J. H. GAUTIER & COMPANY
CORNER OF
GREENE AND ESSEX STREETS,
JERSEY CITY, N. J.
MANUFACTURERS OF
Clay Gas Retorts,
Gas House Tiles,
Fire Bricks, Etc. Etc.
Ground Clay, Fire Brick and Fire Sand in Barrels,
H. GAUTIER, Prest. CHAS. E. GAUTIER, Sec. & Treas.
CHAS. E. GREGORY, V.-Prest. DAVID R. DALY Gen'l Mang'r.

BROOKLYN
Clay Retort & Fire Brick Works,
(EDWARD D. WHITE & CO.)
Manufacturers of Clay Retorts, Fire Brick, Gas House and other Tile.
VAN DYKE, ELIZABETH, RICHARDS & PARTITION STS.
Office, 88 Van Dyke St., Brooklyn, N. Y.

LACLEDE FIRE BRICK MFG. CO.,
MANUFACTURERS OF
Fire Brick, Gas Retorts,
AND
ST. LOUIS STANDARD SEWER PIPE.
Blast Furnace and Cupola Linings, every description of Fire Clay Material, Fire Clay Flue Linings, Chimney Tops Dry Milled and Crude Fire Clays, etc.
OFFICE AND DEPOT
901, 903, and 905 Pine Street,
ST. LOUIS, MO.

ESTABLISHED IN 1845.
B. KREISCHER & SONS,
OFFICE FOOT OF HOUSTON ST., E.R., N.Y.
Gas Retorts,
TILES, FIRE BRICK.
AND EVERYTHING IN THE FIRE CLAY LINE.

MANHATTAN
FIRE BRICK & ENAMELLED CLAY
RETORT WORKS
ADAM WEBER.
CLAY GAS RETORTS
AND RETORT SETTINGS
FIRE BRICKS, TILES, ETC.,
Office and Works, 15th Street and Avenue C., N. Y

Works,
LOCKPORT STATION, PA.
—ESTABLISHED 1864.—
JAMES GARDNER, JR.,
Successor to WILLIAM GARDNER & SON.
Office, Rooms 19 & 20, Lewis Block
PITTSBURGH, PA, P. O. Box 373
Fire Clay Goods for Gas Works.
SOLE REPRESENTATIVE OF THE McILHENNY REGENERATIVE BENCHES FOR THE U. S.
H. A. NORTON, No. 92 WATER STREET, BOSTON, MASS., Agent for the New England States.

HENRY MAURER & SON,
(ESTABLISHED 1856.)
EXCELSIOR FIRE BRICK & CLAY
RETORT WORKS
WORKS, Perth Amboy, N. J.
OFFICE, 418 to 422 East 23d St., N. Y.
Clay Gas Retorts,
BENCH SETTINGS,
Fire Brick, Tiles, Etc.

GEROULD'S IMPROVED RETORT CEMENT.
A Cement of great value for patching retorts, putting on mouth-pieces, making up all bench-work joints, lining blast furnaces and cupolas. This cement is mixed ready for use. Economic and thorough in its work. Fully warranted to stick.
PRICE LIST.
In Casks, 600 to 800 lbs., f.o.b. N. Y., at 5 cents per pound.
In Kegs, 100 to 300 lbs., " " at 6 " "
In Kegs less than 100 lbs., " " at 7 " "
C. L. GEROULD & CO.,
5 & 7 Skillman St., Brooklyn, N. Y.
Western Agent, H. T. GEROULD, Wichita, Kan.

Parker-Russell Mining and Mfg. Co.,
CITY OFFICE,
Mermod-Jaccard Bldg., Rooms 307 & 308,
Broadway & Locust St., St. Louis, Mo.
PROPRIETORS OF THE
OAKHILL GAS RETORT & FIRE BRICK W'KS
Our immense establishment is now employed almost entirely in the manufacture of
Materials for Gas Companies
We have studied and perfected three important points. Our retorts are made to stand changes of temperature, the strongest heats of the furnace, and the abrasion of feeding and emptying. We have the *exclusive Agency for the West* of the celebrated
Kloenne-Bredel Full Depth and Semi-Recuperator Benches,
And also furnish and build
Our Own Styles Semi-Recuperator Furnaces for the use of Coal or Coke as fuel.

THOS. SMITH, Prest. AUGUST LAMBLA, Vice-Prest. & Supt.
BALTIMORE
RETORT & FIRE BRICK CO.
MANUFACTORY AT
LOCUST POINT BALTIMORE MD.
Clay Retorts, Blocks & Tiles
FIRE BRICK, FIRE CLAY,
AND FIRE CEMENT.
Red and Buff Ornamental Tiles and Chimney Tops. Drain and Sewer Pipe (from 2 to 30 inches). Baker Oven Tiles 12x12x2 and 10x10x2.
WALDO BROS., 88 WATER ST., BOSTON, MASS
Sole Agents the New England States.

King's Treatise on Coal Gas. In Three Volumes. Price per Vol., $10. Sold either by Volume or in Sets.
A Standard text-book for the Engineers and Managers of Gas Works, and for all who are concerned or take an interest in the manufacture and distribution of Coal Gas, and in the utilization of the Secondary Products resulting therefrom; treating also of the Gas Engine and of Gas Cooking and Heating Appliances. A. M. CALLENDER & CO., 32 Pine Street, N. Y. City.

FRED. BREDEL, C. E.,

PROP'R OF KLOENNE AND BREDEL PATENTS.

Recuperative Furnaces, Purifying Machines,

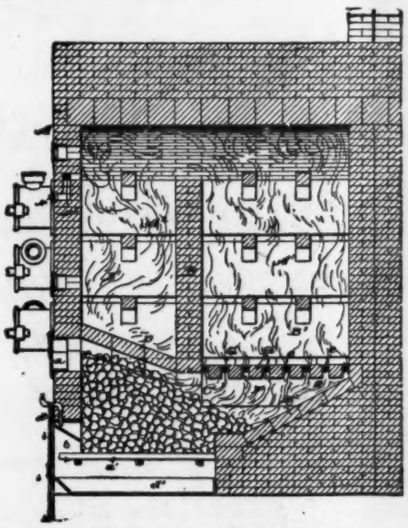
* Gas Apparatus. *

Main Office, 118 Farwell Avenue, Milwaukee, Wis.

New York Office, 22 Beaver Street.

FLEMMING'S

Generator-Gas Furnace



Materials furnished and Benches erected by

J. H. GAUTIER & CO., - Jersey City, N. J.

Address as above, or D. D. FLEMMING, Jersey City, N. J.

AMERICAN GAS LIGHT JOURNAL

$3.00 per Annum.

A. M. CALLENDER & CO.

32 Pine Street, N. Y.

The Miner Street Lamps.

Jacob G. Miner,

No. 823 Eagle Ave., New York, N. Y.

Bartlett Street Lamp Mfg. Co.

MANUFACTURERS OF

Globe Lamps,

FOR

Streets, Parks, Public Buildings, Railroad Stations, etc.

LAMP POSTS

A Specialty.

Office and Salesroom,

40 & 42 COLLEGE PLACE, - - N. Y. CITY.

Gas Companies and others intending to erect Lamps and Posts will do well to communicate with us.

The American Gas Engineer and Superintendent's Handbook.

By WM. MOONEY.

350 Pages, Full Gilt Morocco. Price, $3.00.

A. M. CALLLENDER & CO., 32 Pine St., N. Y.

DAVIS & FARNUM MFG. CO.,

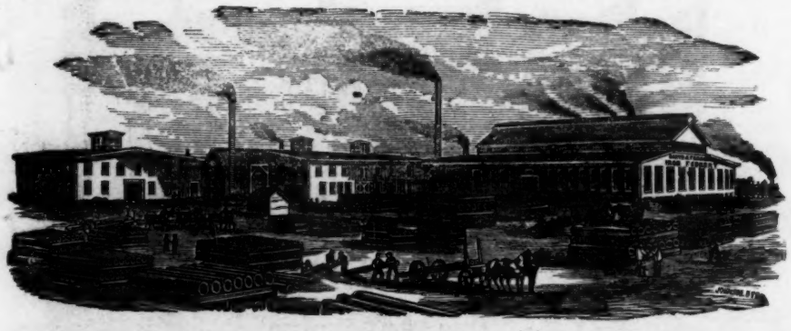
WALTHAM, MASS.

PRINCIPAL OFFICE AND WORKS, Waltham, Mass. BOSTON OFFICE, Room 18, Vulcan Building, 8 Oliver Street.

SINGLE, DOUBLE, AND TRIPLE LIFT

Gasholders.

OF ANY CAPACITY.



TUBULAR, PIPE, AND SINUOUS FRICTION

Condensers.

OF ALL SIZES.

IRON ROOF FRAMES AND FLOORS.

Purifying Boxes, Center Seal or Valve Connections, Bench Work.

Reversible Lime Trays.

SELF-SEALING AND PRESSED STEEL MOUTHPIECE LIDS.

Coke Barrows, Coal Wagons, and all Apparatus Requisite for a Complete Gas Plant

—ALSO—

Gas and Water Pipe, Flanged Pipe,

Sugar House Work, and Special Castings of all Descriptions.

Established 1861. **Incorporated 1881.**

KERR MURRAY MFG. CO.,

FORT WAYNE, IND.

Those who are in need of

Holders or Gas Works Apparatus of any Description,

AND OF THE LATEST IMPROVEMENTS,

will find it to their interest to

GET AN ESTIMATE FROM US

before placing their order.

As we make a Specialty of this Class of Work, and are Practical Builders and Manufacturers of same,

with our long years of experience in the business,

WE CAN GUARANTEE YOU SATISFACTION.

Estimates, Plans and Specifications Furnished on Application.

BARTLETT, HAYWARD & CO.

Baltimore, Md.

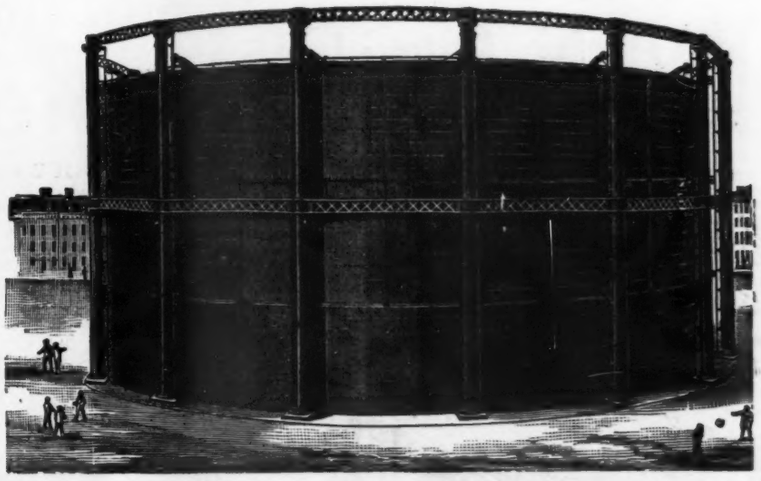
Triple Double, & Single-Lift
GASHOLDERS.

Iron Holder Tanks.

ROOF FRAMES.

Girders.

BEAMS.



PURIFIERS.

CONDENSERS.

Scrubbers.

BENCH CASTINGS.

OIL STORAGE TANKS.

Boilers.

The Wilkinson Water Gas Process.

THIRTY-CANDLE, NON-CONDENSABLE, FIXED GAS. THE MOST SUCCESSFUL GAS PROCESS IN OPERATION.

Munich Regenerative Furnace, System Drs. Schilling & Bunte.

MILL'S REVERSIBLE LIME TRAYS.

Gas Works Designed and Constructed.

Pascal Iron Works. ESTABLISHED —1821.— Delaware Iron Works.

MORRIS, TASKER & CO.,

INCORPORATED.

OFFICE, 224 SOUTH THIRD STREET, - - PHILADELPHIA, PA.

CONTRACTORS, BUILDERS, AND MANUFACTURERS OF

Gas, Water & Sugar Works

Bench Castings.

Condensers.

Scrubbers.

Purifiers.

Hyd. Carriages.

Iron Floors,

Iron Roofs.

Street Stops,

Valves, etc.

Stand-Pipes.

Water & Oil

Tanks, all Sizes.

Single, Double, and Triple-Lift Gas Holders.

SELF-SEALING RETORT LIDS. STAMPED STEEL RETORT LIDS.

Locomotive Water Columns, Filters, etc. Boiler Tubes, Wrought Iron Pipe & Fittings.

Plans, Specifications and Estimates for all kinds of Machinery furnished on application.

Foundries and Works: { Millville, N. J. / Florence, " / Camden, "

R. D. WOOD & CO.

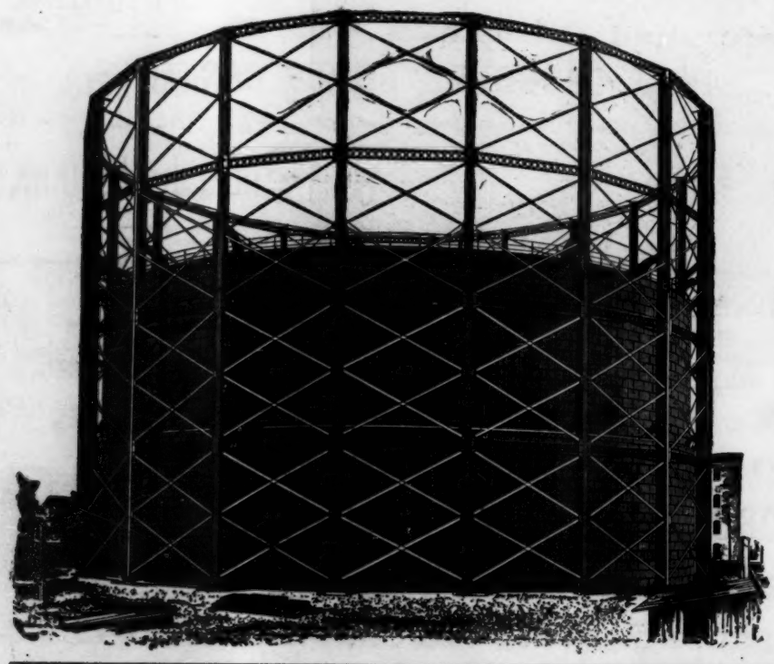
Engineers, Iron Founders, Machinists.

No. 400 Chestnut Street,

PHILADELPHIA, PA.

MANUFACTURERS OF

CAST IRON PIPE.



GAS HOLDERS

SINGLE, DOUBLE AND TRIPLE LIFTS,
WITH OR WITHOUT
WROUGHT IRON OR STEEL TANKS.

PURIFIERS. CONDENSERS. SCRUBBERS.

SOLE MAKERS OF

The Standard Mitchell Scrubbers.

(PATENTED)

THE HOPPER AUTOMATIC GAS GOVERNOR,
BENCH WORK,
PLATE GIRDERS, IRON FLOORS AND ROOFS,
THE TAYLOR REVOLVING-BOTTOM GAS-PRODUCER,
HEAVY LOAM CASTINGS.

HYDRAULIC WORK,
LAMP POSTS, VALVES, ETC.

ISBELL-PORTER COMPANY,

G. G. PORTER, Prest. (Successors to SMITH & SAYRE MFG. COMPANY) CHAS. W. ISBELL, Secy.

ENGINEERS AND CONTRACTORS FOR THE

Construction and Extension of Gas Works.

Special Castings, Tees, Bends, etc.
Bench Castings.
Water Gas Generators.
Hydraulic Mains.
Iron Floors.
Brenner Self-Sealing Retort Lids.
Tar Gates and Hydraulic Main Dip Regulators.
Hutchison's Tar Displacement Apparatus.
Multitubular Condensers.
Standard Washer-Scrubbers.
Tower Scrubbers.
Walker's Tar and Carbonic Acid Extractors.
Exhausters.
Engines.
Steam Jet Exhausters.
Exhauster Governors.
Compensators.
Self-Acting Bye-Pass Valves.
Valves.
Valve Stands with Indicators.
Purifying Boxes.
Purifier Valve System.
Center Seals.
Street Governors.

Estimates, Drawings and Specifications Furnished for the Alteration, Improvement, or Extension of Existing Works or the Construction of New Works.

ISBELL-PORTER COMPANY,

No. 245 Broadway, New York City.

JAMES R. FLOYD & SONS,
(SUCCESSORS TO HERRING & FLOYD)
Oregon Iron Works,
W. 20th & 21st. Sts., bet. 10th & 11th Avs.,
NEW YORK CITY.
Engineers and Contractors
FOR THE
CONSTRUCTION OF GAS WORKS.
MANUFACTURERS OF
All Kinds of Castings and General Ironwork
FOR
GAS APPARATUS.
Bench Castings, Regenerative and Half Regenerative Furnace Castings.
Condensers, Scrubbers, Purifiers, Street Drips and Connections,
Valves,
Hydraulic Hoisting Purifier Carriage, Self-Sealing Retort Lids, Improved Valve Stand and Indicator, Seller's Cement.
Plans, Specifications, and Estimates furnished for Construction of New or Alteration of Old Works.

Bouton Foundry Co.,
FOUNDERS AND MACHINISTS,
CHICAGO, ILL.
Gas Works Apparatus,
PURIFIERS, CONDENSERS,
Bench Work
SPECIALS. LAMP POSTS,
SCRUBBERS,
Iron Roofs and Floors.
Plans and Estimates furnished for new works or extensions of old works.

H. RANSHAW, Prest. & Mangr. WM. STACEY, Vice-Prest. T. H. BIRCH, Asst. Mangr. R. J. TARVIN, Sec. & Treas.
STACEY MFG. CO.,
MANUFACTURERS OF
Single and Telescopic Gasholders,
IRON ROOFS, BRIDGES, LAMP POSTS,
Water and Oil Tanks, Coal Elevator Cars,
COKE CRUSHERS, BENCH CASTINGS,
And all kinds of Wrought and Cast Iron Work used in the erection of Coal and Oil Gas Works. Rolling Mill Machinery and Heavy Castings a Specialty.
Foundry: 33, 35, 37 & 39 Mill Street.
Wrought Iron Works: 16, 18, 20, 22, 24 & 26 Ramsey Street.
Cincinnati, Ohio.

1842. **DEILY & FOWLER,** 1892.
Laurel Iron Works.
Address, No. 39 Laurel Street, Philadelphia, Pa.
BUILDERS OF
GASHOLDERS,
Single and Telescopic.
Holders Built 1885 to 1891, Inclusive

Chester, Pa.	Little Rock, Ark.	Northern Gas Lt. Co., of	Calais, Me.	Victoria, B. C.
Hazleton, Pa. (2d.)	Irvington, N. Y.	New York, N. Y.	New London, Conn. (2d)	Vancouver, B. C.
Staten Island, N. Y.	South Boston, Mass.	Willimantic, Conn	West Chester, N. Y.	Charlottesville, Va.
Saugerties, N. Y.	Rye, N. Y. (2)	Montclair, N. J.	Bay Shore, L. I.	So. Framingham, Mass.
Clinton, Mass. (Lan. Mills)	Woodstock, Ont.	Attleboro, Mass.	Washington, D. C.	Woonsocket, R.
Chattanooga, Tenn.	Malden, Mass.	Santa Cruz, Cal.	Newport, R. I. (2d)	Simcoe, Can.
Galveston, Texas. (3d.)	Staten Island, N. Y. (2d)	Erie, Pa. (2d)	Morristown, N. J.	Pittsfield, Mass. (2d)
Fort Plain, N. Y.	Woodstock, Ont.	West Chester, Pa. (2d	Lebanon, Pa.	Chattanooga, Tenn. (2d)
Brunswick, Ga.	Malden, Mass.	Lancaster, Pa. (3d	Oakland, Cal.	So. Bethlehem, Pa. (2d)
Port Chester, N. Y.	Paducah, Ky.	Tacony, Pa. (two)	Central Gas Lt. Co., New	"Vassar College," N. Y
New Rochelle, N. Y.	Norwich, Conn.	Mount Vernon, N. Y	York City (2d)	So. Chester, Pa.
Salem, N. J. (3d)	Seattle, W. T.	Binghamton, N. Y.	Tacoma, Wash.	Cumberland, Md.
Omaha, Neb. (2d)	San Diego, Cal.	Concord, N. H.	Knoxville, Tenn.	Auburn, N. Y.
Lynn, Mass. (2d)	Westerly, R. I.	Dover, Del. (2d)	Pottstown, Pa.	DesMoines, Ia.

ILLUMINATING GAS! FUEL GAS!
The Loomis Process.
Now in successful operation at Works of John Russell Cutlery Co., Turner's Falls, Mass., and Henry Disston's Sons' Saw Works, Tacony, Pa.
The Cheapest Gas Generating System in the World.
Plans and Estimates Furnished.
BURDETT LOOMIS, - - Hartford, Conn.

WM. HENRY WHITE,
No. 32 Pine Street, - - - New York City.
ENGINEER AND CONTRACTOR FOR THE
ERECTION AND EXTENSION OF
GAS, WATER, AND ELECTRIC LIGHT WORKS.
Correspondence with Gas Companies contemplating extending or improving their Plants respectfully invited.
Plans and Estimates Furnished

GAS COALS. CANNEL COALS. COKE CRUSHERS.

JAMES D. PERKINS. **PERKINS & CO.,** F. SEAVERNS.

228 & 229 Produce Exchange, New York.

Cable Address, "PERKINS, NEW YORK." Post Office Box 3695, New York.

GENERAL SALES AGENTS FOR

The Youghiogheny River Coal Company's

OCEAN MINE YOUGHIOGHENY GAS COAL.

This Colliery is located at Scott Haven, Pa., in the center of the Youghiogheny Gas Coal District, and produces the only reliable Youghiogheny Coal for gas purposes. (See Map on p. 87 of this JOURNAL, Feb. 16, '85.)

Shipment from LOCUST POINT, BALTIMORE.

ALSO, SOLE SHIPPERS OF THE

Old Kentucky Shale, From Kentucky.

TRADE O. K. SHALE. MARK.

THE MOST VALUABLE GAS ENRICHER NOW AVAILABLE IN ANY DESIRED QUANTITY.

S. CALVERT FORD, Government Inspector at Washington, pronounces this Shale

"ONE OF THE BEST GAS ENRICHERS THAT HAS BEEN OFFERED TO THE TRADE."

He reports it as giving:

12,553 Cu. Ft. of 50-Candle Gas, or 10,460 Cu. Ft. of 60-Candle Gas, } An Equivalent of 627,650 Candle Feet, { And 808 Pounds of Merchantable Coke.

Single carloads or more delivered at any required point in the United States and Canada. Cargo shipments from

New York, Philadelphia, Baltimore and Newport News.

WE CAN ALSO SUPPLY A LIMITED QUANTITY OF

BRECKENRIDGE CANNEL.

Particulars as to Prices, etc., furnished upon application to the above address.

JAMES & WILLIAM WOOD,

Gas and Cannel Coal Contractors,

No. 40 St. Enoch Sq., Glasgow. No. 2 Talbot Court, London.

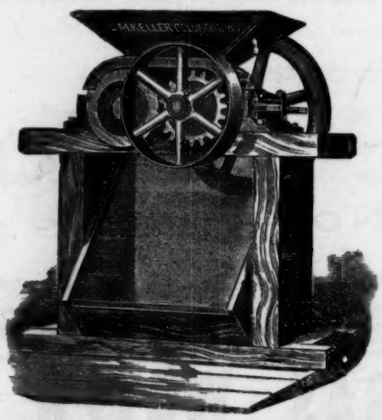
Proprietors of the **BATHVILLE COLLIERIES** (which produce the celebrated **BOGHEAD CANNEL**), Shields, Shieldmuir, Drumpeller, and other Collieries. This Firm offer

STANDARD CANNELS,

Unequaled as Gas Enrichers.

Analyses, prices, and all further information furnished on application to

Agency for U.S., Room 70, Nos. 2 & 4 Stone St., N.Y. City.



Keller's Adjustable Coke Crusher

SIMPLE, STRONG, AND DURABLE.

O. M. Keller, Sec. & Supt. Gas Lt. & Coke Co. Columbus, Ind.

Correspondence Solicited.

GAS ENRICHERS.

The Despard Gas Coal Co.,

MINERS AND SHIPPERS OF

DESPARD GAS COAL,

AND MANUFACTURERS OF

COKE.

MINES, Clarksburg, Harrison Co., W. Va.
WHARVES, Locust Point, Baltimore, Md.
OFFICE, 44 South Street, Baltimore, Md

ROUSSEL & HICKS, 71 Broadway, N. Y. } AGENTS. { BANGS & HORTON, 60 Congress St., Boston.

JOS. R. THOMAS,

No. 32 Pine Street, N.Y. City.

CONSULTING AND CONSTRUCTING

Gas Engineer and Contractor.

PLANS, SPECIFICATIONS, AND ESTIMATES FURNISHED.

Contracts taken for all Appliances required at a Gas Works,

Either for New Works or Extensions to Old Plants.

H. C. SLANEY,

Gas Engineer

446 E. 116th Street, New York.

Plans, Specifications and Estimates furnished for New Works, Alteration or Extension of Old Plants.

JAMES R. SMEDBERG,

Gas Engineer,

213 Jefferson Ave., Peoria, Ill.,

Will furnish Plans, Specifications and Estimates for the Remodeling or extension of Gas Works. Also, Analytic Reports upon the business condition and prospects of Gas Companies. Ample references will be given.

The Chemistry of Illuminating Gas.

By NORTON H. HUMPHRYS. Price, $2.40.

A. M. CALLENDER & CO., 32 PINE ST., N. Y. CITY.

GAS COALS.

THE PENN GAS COAL CO.

OFFER THEIR

Coal, Carefully Screened & Prepared for Gas Purposes.

Their Property is located in the Youghiogheny Coal Basin, near Irwin and Penn Stations on the Pennsylvania Railroad, and on the Youghiogheny River.

Principal Office:

209 SOUTH THIRD STREET, PHILA., PA.

Points of Shipment:

Pennsylvania Railroad Piers; Greenwich Wharves, Delaware River: Pier No. 1 (Lower Side), South Amboy, N. J.

Chesapeake & Ohio Railway Coal Agency,

FOR THE SALE OF THE

Superior Kanawha Gas Coals, Cannelton Cannel,

Also, SPLINT AND STEAM COALS

From the Kanawha and New River Regions, on the line of the Chesapeake & Ohio R'way.

C. B. ORCUTT, General Agent, - - No. 1 Broadway (Room 217) New York City

EDMUND H. MCCULLOUGH, Prest CHAS. F. GODSHALL, Treas. H. C. ADAMS, Sec.

THE WESTMORELAND COAL CO.

Chartered 1854.

Mines situated on the Pennsylvania and the Baltimore and Ohio Railroads, in Westmoreland County, Penn.

POINTS OF SHIPMENT:

PHILADELPHIA, BALTIMORE, SOUTH AMBOY. N. J.
WATKINS (SENECA LAKE), N. Y.

Since the commencement of operations by this Company its well-known Coal has been largely used by the Gas Companies of New England and the Middle States, and its character is established as having no superior in gas giving qualities, and in freedom from sulphur and other impurities.

Principal Office, 224 South 3d St., Phila., Pa

Standard Oil Company,

GAS NAPTHA DEPARTMENT.

GAS NAPTHA.

GAS OIL.

Correspondence Solicited.

26 Broadway, New York City.

JOHN J. GRIFFIN & CO.,

Nos. 1513, 1515, 1517 & 1519 Race Street, PHILADELPHIA.
No. 52 Dey Street, NEW YORK. No. 75 North Clinton Street, CHICAGO.

MANUFACTURERS OF

METERS FOR MEASURING GAS

IN ANY VOLUME.

Provers, Gauges, Registers, Etc., Etc.

EXPERIMENTAL APPARATUS FOR QUANTITATIVE AND QUALITATIVE ANALYSIS.

Careful and Prompt Attention paid to Repairing of all kinds of Meters and Apparatus.

Estimates Cheerfully Furnished.

Dry Gas Meters.

With 40 years' experience and the best facilities for manufacturing, is enabled to furnish reliable work and answer orders promptly.

NATHANIEL TUFTS,

No. 153 Franklin Street, Boston, Mass.,

MANUFACTURER OF

DRY GAS METERS.

Station Meters of any Capacity.

Test and Experimental Meters, Pressure Registers, Pressure Gauges, Pressure and Vacuum Gauges.

METER PROVERS, PHOTOMETERS, STREET LANTERNS, ETC., ETC.

Patent Cluster Lanterns for Street Illumination.

CHARLES E. DICKEY. JAMES B. SMALLWOOD. CHARLES H. DICKEY.

THE MARYLAND METER AND MANUFACTURING CO.

Established 1866.

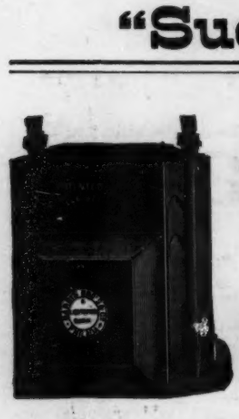
BALTIMORE, North & Saratoga Sts. **CHICAGO, 122 & 124 Michigan St.**
NEW YORK, 838 Broadway. **SAN FRANCISCO, 221 Front St.**
BOSTON, 92 Water Street, Rooms 21 and 22.

CONSUMERS' & STATION METERS, PRESSURE GAUGES, Etc., Etc.

"Success" and "Perfect" Gas Stoves.

A. HARRIS. E. L. HARRIS. J. A. HARRIS.

Established 1849.



HARRIS BROS. & CO.,

Twelfth and Brown Streets, Phila., Pa. Agency, 67 & 69 S. Canal Street, Chicago.

S. S. STRATTON, Manager, Chicago.

Manufacturers of Wet and Dry Gas Meters,

STATION METERS, METER PROVERS,

EXPERIMENTAL METERS, SHOW OR GLAZED METERS,

Pressure and Vacuum Registers, Gauges, Photometers, Drip and Bell Pumps, Etc., Etc.

PROMPT ATTENTION GIVEN TO ALL ORDERS. METERS THOROUGHLY REPAIRED. ESTIMATES FURNISHED FOR STATION METERS OF ALL SIZES. CORRESPONDENCE SOLICITED.

GAS METERS. GAS METERS. GAS METERS.

GEO. J. McGOURKEY, Prest. WM. H. McFADDEN, Vice-Prest. (Phila.) WM. N. MILSTED, Gen. Supt. and Treas. (New York). WM. H. DOWN, Sec.

THE AMERICAN METER CO.

Established 1834. Incorporated 1863.

WET AND DRY GAS METERS. PRESSURE REGISTERS. METER PROVERS.
STATION METERS. PRESSURE & VACUUM REGISTERS. PORTABLE TEST METERS.
EXHAUSTER GOVERNORS. PRESSURE & VACUUM GAUGES. EXPERIMENTAL METERS.
DRY CENTER VALVES. CRESSON GAS REGULATORS. AMMONIA TEST METERS.
GOVERNORS FOR GAS WORKS. MARSLAND WATER METERS. BAR & JET PHOTOMETERS.

Manufactories:
512 West 22d St., N. Y.
Arch & 22d Sts., Phila.

GAS STOVES.
SUGG'S "STANDARD" ARGAND BURNERS,
SUGG'S ILLUMINATING POWER METER,
Wet Meters, with Lizar's "Invariable Measuring" Drum.

Agencies:
177 Elm Street, Cincinnati.
125 & 127 S. Clinton Street, Chicago.
810 North Second Street, St. Louis.
222 Sutter Street, San Francisco.

HELME & McILHENNY,

(Established 1848.)

GAS METER MANUFACTURERS,

Nos. 1339 to 1349 Cherry Street, Philadelphia, Pa.,

WET AND DRY GAS METERS, STATION METERS, EXPERIMENTAL METERS, METER PROVERS,

Center Seals, Pressure Registers, Governors, Indicators, Photometers, and all other kinds of Apparatus for use in Gas Works.

FOULIS' PATENT STATION AND DISTRICT GOVERNORS.

REPAIRING DEPARTMENT.—We employ a special force of skilled workmen repairing meters of **all makers.**

D. McDONALD & CO.,

Established 1854.

154 West 27th Street, NEW YORK CITY. | **51, 53 & 55 Lancaster St., ALBANY, N. Y.** | **34 & 36 W. Monroe St., CHICAGO, ILL.**

MANUFACTURERS OF

Wet and Dry Gas Meters

STATION METERS, EXPERIMENTAL METERS, METER PROVERS, PRESSURE & VACUUM REGISTERS & PRESSURE GAUGES.

Meters of all makers Thoroughly Repaired.

KEYSTONE METER CO.
ROYERSFORD, PA.

CHAS. V. NEWMAN, Western Mangr.,
1484-1485 Unity Bldg., Chicago, Ills.

DRY GAS METERS.
STATION METERS.
METER PROVERS.
REPAIRING.

SPECIAL.—Having purchased the sole right to manufacture and sell meters with the HEARNE IMPROVED VALVE, in the U. S., we respectfully solicit orders for the same.

The superior feature of this meter is that it avoids the danger of displacement of the valves, and consequent loss of gas, either in shipping, handling, or by dishonest consumers.

To designate from the regular Glover Meter, also made by us, we style the above the HEARNE-GLOVER Meter.

It is worth your consideration.

Full descriptive circular sent on application.

W. WALLACE GOODWIN, President. E. STEIN, Vice-President. WM. E. STEEN, Sec. & Treas. H. B. GOODWIN, Superintendent.

THE GOODWIN GAS STOVE AND METER COMPANY,

1012, 1014 & 1016 Filbert Street, Philadelphia, Pa.

113 Chambers St., N. Y. 44 & 46 Dearborn St., Chicago. Agts., Waldo Bros., 88 Water St., Boston.

SOLE MANUFACTURERS OF THE

"Sun Dial" Gas Stoves,

IN A GREAT VARIETY OF STYLES AND SIZES.

Gas Cooking Stove No. 7C.

The Most Economical, Efficient, and Durable Gas Stove Made.

SIZE.

Stove.	*Oven.*	*Broiler.*	*Top.*
31 inches high.	9⅝ inches high.	10 inches high.	21 inches high.
17 inches wide.	15 inches wide.	15 inches wide.	16 inches wide.
	12¾ inches deep.	12¾ inches deep.	
	Length over extension shelves, 32 inches.		

This Stove has three Boiling Burners in the Top or Hot Plate, and single Oven Burner.

The consumption of this Stove is 35 cubic feet per hour, at 1½ inch pressure with all burners.

Three-eighth inch supply pipe should be used when the pressure is 1½ inches or over.

ALL FITTINGS ARE NICKEL PLATED.

Catalogue showing Styles and Prices sent free on application.

DRY and WET GAS METERS

Station Meters (square, cylindrical, or in staves), Glazed Meters, King's and Sugg's Experimental Meters, Lamp Post Meters, etc., etc.

METER PROVERS (Sizes 2, 5 and 10 feet.)

Pressure Gauges of all kinds, Pressure Registers, Pressure and Vacuum Registers, Pressure Indicators (sizes 4, 6 and 9 in.), King's Pressure & Vacuum Gauges.

DRY & WET CENTER SEALS, DRY & WET GOVERNORS, EXHAUSTER GOVERNORS.

Photometers of all descriptions. Letheby's Sulphur and Ammonia Test Apparatus Complete.

Also, TESTING AND CHEMICAL APPARATUS OF ALL KINDS, AND OF THE MOST PERFECT DESCRIPTION, FOR ALL PURPOSES RELATING TO GAS.

GOODWIN'S IMPROVED LOWE'S JET PHOTOMETER.

Agents for Bray's Patent Gas Burners and Lanterns.

Special attention to Repairs of Meters and all Apparatus connected with the business. All work guaranteed first-class in every particular. Orders filled promptly.